# GLOSSARY OF TERMS

**40 CFR Part 191.** *Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes*. This regulation sets environmental radiation protection standards for management (Subpart A) and disposal (Subparts B and C) of spent nuclear fuel and high-level and transuranic radioactive wastes.

**40 CFR Part 194.** This regulation provides EPA's *Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with 40 CFR Part 191 Disposal Regulations.*

**40 CFR Part 261.** *Identification and Listing of Hazardous Waste*. This part identifies those solid wastes which are subject to regulation as hazardous wastes under Parts 262B265, 268, 270, 271, and 124 of Title 40 of the Code of Federal Regulations.

**40 CFR Part 264.** *Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities*. This subpart establishes minimum national standards which define the acceptable management of hazardous waste.

**40 CFR Part 264, Subpart G.** This subpart of 40 CFR Part 264 defines closure and post-closure requirements pertaining to hazardous waste management units.

**40 CFR Part 264, Subpart X.** This subpart specifies requirements that apply to owners and operators of facilities that treat, store, or dispose of hazardous waste in miscellaneous hazardous waste management units.

**40 CFR Part 268.** This regulation restricts the land disposal of hazardous waste and specifies treatment standards and/or treatment technologies that must be met or applied before hazardous wastes may be land disposed. Section 268.6 provides for petitioning to allow land disposal of untreated hazardous waste if it can be demonstrated to a reasonable degree of certainty that there will be no migration of hazardous constituents from the disposal unit for as long as the waste remains hazardous.

**40 CFR Part 270.** This regulation establishes provisions for the Hazardous Waste Permitting Program under Subtitle C of the Resource Conservation and Recovery Act. This regulation and the associated State of New Mexico regulation require the permitting of the WIPP as a hazardous waste facility.

**abscissa.** The horizontal coordinate (x coordinate) of a point plotted in Cartesian (x, y) coordinates.

**absolute temperature.** Temperature measured in degrees Celsius from absolute zero, -273.18 °C. Absolute temperatures are given either as "degrees absolute" (for example, 150°A) or as degrees kelvin (for example, 150°K).

**absorption.** The process by which a fluid penetrates or is drawn into and held in the inner structure of another (solid or liquid) material. The word also appears in contexts such as absorbed energy and absorbed radiation dose, in which case it refers to internal energy imparted to the absorbing material. Absorbed radiation dose refers specifically to the energy imparted by ionizing radiation per unit mass of irradiated material at a particular location.

**accessible environment.** "(1) [T]he atmosphere, (2) land surfaces, (3) surface waters, (4) oceans, and (5) all of the lithosphere that is beyond the controlled area." (40 CFR § 191.12)

**acid rain.** Any form of precipitation having a pH of 5.6 or less. Major components contributing to the acid rain are sulfur dioxide and oxides of nitrogen.

**actinide intrinsic colloids.** Macromolecules or aggregations of actinide compounds which form by exsolution of dissolved actinide compounds and remain in suspension, thereby acting as colloids.

**actinide source term.** Modeling terminology denoting the fraction of total actinide inventory of a disposal room or the repository that can be mobilized for transport.

**active institutional control.** (1) Controlling access to a disposal site by any means other than passive institutional controls, (2) performing maintenance operations or remedial actions at a site, (3) controlling or cleaning up releases from a site, or (4) monitoring parameters related to disposal system performance. (40 CFR § 191.12)

**activity.** A measure of the rate at which a material emits nuclear radiation, usually given in terms of the number of nuclear disintegrations occurring in a given length of time. The unit of activity used in this document is the curie (Ci).

**adsorption.** (1) The net accumulation of matter at the interface between a solid phase and an aqueous solution through the formation of two-dimensional (that is, noncrystallographic) molecular structures. The accumulated matter is the *adsorbate*. The solid surface is the *adsorbent*. (2) Adherence of gas molecules to the surface of solids in which they are in contact.

**advection.** The transport of matter (for example, a trace contaminant) by motion of the medium in which it is contained. The most common transport medium is the flow of a fluid.

**aeolian.** Also spelled eolian. Applies to the erosional action of wind, and to deposits which are due to the transporting action of wind.

**aerobic degradation.** The microbial degradation of organic (that is, cellulosic, rubber, plastic, etc.) wastes using oxygen ($O_2$) as the electron acceptor and producing carbon dioxide ($CO_2$) and water ($H_2O$).

**aeromagnetic survey.** Refers to the geomagnetic observations using a magnetometer from an airborne craft.

**air lock.** An intermediate chamber between zones of different static pressure.

**alluvial.** Pertaining to or composed of alluvium, or deposited by a stream or running water. For example, an alluvial clay or an alluvial divide.

**algal features.** Features created by the secretion of calcium carbonate from algae.

**alkalophilic bacteria.** Bacteria that can grow and reproduce well in an alkaline (high pH) environment.

**alpha emitter.** A radioactive isotope that decays through the emission of alpha particles.

**alpha particle.** (α-particle). A positively charged particle emitted in the radioactive decay of certain nuclides. Made up of two protons and two neutrons bound together, it is identical to the nucleus of a helium atom. It is the least penetrating of the three common types of ionizing radiationCalpha, beta, and gamma radiation.

**alternative conceptual models.** Alternative sets of assumptions that describe the same system for the same purpose and are consistent with the existing information.

***AMWTP. A program designed to retrieve, characterize, prepare and store CH-TRU waste at the INEEL for shipment to the WIPP. The CH-TRU waste at INEEL consists of debris and non-debris wastes. The debris wastes will be processed through a sort, size, and volume reduction (supercompaction) process (i.e., treated AMWTP waste). The non-debris waste also will be retrieved, characterized, prepared and stored for shipment to WIPP, but will not be supercompacted. The DOE expects that the AMWTP will ship both supercompacted and uncompacted waste concurrently.***

**anaerobic.** The microbial degradation of organic (that is, cellulosic, rubber, plastic, etc.) wastes in the absence of oxygen ($O_2$), usually consuming nitrate ($NO_3$) as the electron acceptor and producing carbon dioxide ($CO_2$), nitrous oxide ($N_2O$), and nitrogen ($N_2$).

***angular velocity. The rate of rotation of the drill stem, to which the drill bit is attached.***

**anhydrite.** A mineral consisting of anhydrous calcium sulfate ($CaSO_4$). It is gypsum without water and is denser, harder, and less soluble.

***anhydrite lithologies. The description of a rock type, in this case an anhydrous calcium sulfate.***

**annual committed effective dose.** The committed effective dose resulting from a one-year intake of radionuclides released plus the annual effective dose caused by direct radiation

from facilities or activities subject to Subparts B and C of 40 CFR Part 191. (40 CFR § 191.12)

**annulus.** The area between the borehole wall and the outside of the drill pipe in rotary drilling operations. Rotary drilling is used for scientific investigation studies, such as the WIPP project, and the exploration for natural resources (that is, oil and gas).

**anoxic.** Describes a process that occurs in the absence of oxygen ($O_2$). Anoxic corrosion of steels, iron-base alloys, and other metal wastes use water ($H_2O$) or hydrogen sulfide ($H_2S$) and produces hydrogen gas ($H_2$).

**anthropogenic.** Resulting from the influence of human beings on nature (that is, acid rain, greenhouse effect, and man-made organic material).

**anticline.** A fold of rocks whose core contains the stratigraphically older rocks; it is generally convex upward.

***Anticipated Waste Inventory. The sum of the stored and projected TRU waste inventories at currently listed DOE TRU waste sites that have not been emplaced at WIPP.***

**aquifer.** An underground geological formation or part of a formation that is capable of yielding a significant amount of water to a well or spring. (40 CFR § 191.12)

**arenaceous.** Of the texture or character of sand.

**argillaceous rocks.** A group of detrital sedimentary rocks with a grain or particle size less than 1/16 millimeter. Commonly comprised of clay minerals and including shales, mudstones, siltstones, and marls.

**artesian.** Adjective that refers to groundwater confined under pressure so that it will rise in a well. Sometimes the word is used to mean that the water flows out at the surface, but that, strictly speaking, is "flowing artesian."

**assurance requirements.** Qualitative requirements in 40 CFR § 191.14 that specify actions and procedures to increase confidence that the probabilistic release events in the containment requirements (40 CFR § 191.13) will be met.

**Atoka.** The Early-Middle Pennsylvanian rocks, assigned to the Atokan or Derryan Stage, consist of dark-colored sandstones, shales and limestones, which attain a maximum thickness of about 1,000 feet.

**atomic weights.** Atomic weight is the total mass of an atom and is almost, but not exactly, the sum of the masses of its constituent protons, neutrons and electrons.

**attenuation.** (1) A reduction in the amplitude or energy of a signal, such as might be produced by passage through a filter. (2) A reduction in the amplitude of seismic waves, as

produced by divergence, reflection and scattering, and absorption. (3) That portion of the decrease in seismic or sonar signal strength with distance that is not dependent on geometrical divergence, but on the physical characteristics of the transmitting medium.

**authigenic.** Formed or generated in place of rock constituents and minerals that have not been transported or that crystallized locally at the spot where they are now found, and of minerals that came into existence at the same time as, or subsequently to, the formation of the rock of which they constitute a part. The term often refers to a mineral (such as quartz or feldspar) formed after deposition of the original sediment.

**backfill.** Material placed around or above the waste containers, filling the open space in the disposal room.

**background (radiation).** Radiation in the human environment from naturally occurring elements, fallout, and from cosmic radiation.

**bacterioruberin.** A carotenoid pigment excreted during growth and multiplication of various strains of bacteria that may be involved in waste decomposition.

**barrier.** "Any material or structure that prevents or substantially delays movement of water and/or radionuclides toward the accessible environment. For example, a barrier may be a geologic structure, a canister, a waste form with physical and chemical characteristics that significantly decrease the mobility of radionuclides, or a material placed over and around waste, provided that the material or structure substantially delays movement of water or radionuclides." (40 CFR § 191.12) Barriers also prevent or delay the movement of hazardous constituents.

**Baseline Inventory Report.** Also known as the Transuranic Waste Baseline Inventory Report. This document provides the total DOE transuranic waste inventory. The Baseline Inventory Report establishes a methodology for grouping wastes of similar physical and chemical properties from across the DOE transuranic waste system into a series of waste profiles.

**bedding plane.** A flat or near-flat bedding surface that visibly separates the individual layers, beds, or strata in sedimentary or stratified rocks from the preceding or following layers.

**Bell Canyon Formation.** A sequence of rock strata that form the uppermost formation of the Delaware Mountain Group (Early Permian). It is immediately below the Castile Formation and about 4,000 feet below the surface at the WIPP. May contain some oil and gas.

**bentonite.** A commercial term applied to expansive clay materials containing montmorillonite (smectite) as the essential mineral.

**beta particle.** (β-particle). A negatively charged particle emitted in the radioactive decay of certain radioactive elements (nuclides). A beta particle is identical to an electron. It is

not a strong penetrating radiation and can be stopped by an inch of wood or a thin sheet of aluminum.

**biodegradation.** The process of consumption by microbial substancesCusually organic materials such as cellulosics.

**bioelectric activity.** The electric phenomena associated with organic matter (plants and animals).

**biofilm ecosystem.** An ecosystem composed of substrates and nutrients developed on surfaces containing one or more layers of cells with extra cellular polymeric material.

**biological half-life.** The time required for an organism to eliminate half the amount of a radionuclide ingested or inhaled. See definition for half-life.

***bleb. A small, usually rounded inclusion of one mineral in another.***

**blowout.** An unexpected volume of gas or fluid released from subsurface pressurized zones that flows upwards to the land surface and into the atmosphere during the drilling of a borehole.

**Boltzmann Constant.** The ideal gas constant per molecule is the ratio of the molar gas constant to the number of molecules per gram of a substance. Boltzman's Constant is defined as having a value of approximately $1.380 \times 10^{-23}$Joules/Molecule K.

**borehole.** (1) A hole drilled from the surface for purposes of geologic or hydrologic testing, injection, or exploration and subsequent production of resources; sometimes referred to as a drillhole or well bore. (2) A man-made hole in the wall, floor, or ceiling of a subsurface room used for verifying geology, making observations, or emplacing canisters of remote-handled transuranic waste.

**brackish.** Water with between one and ten parts per thousand salinity. This places the saline content of brackish waters between that of streams and sea water. See saline and brine.

**BRAGFLO.** The name of the computer model the DOE uses to simulate brine and gas flow in the disposal system.

**breccia.** Fragmented rock whose components are angular and cemented together by a mineral cement or a fine-grained matrix. May be sedimentary (for example, carbonate or evaporite karst features) or formed by crushing or grinding along faults. There are friction or fault breccias, talus breccias, eruptive breccias, and large-scale collapse sinks (for example, breccia pipes). Breccia pipes are vertical or near vertical cylindrical features filled with collapse debris.

**brine.** Water with greater than 100 parts per thousand salinity. Brines are often found in deep sedimentary basins and contain calcium (Ca), sodium (Na), potassium (K), chloride (Cl), sulfate ($SO_4$), and minor amounts of other elements.

**brine pocket.** See brine reservoir.

**brine reservoir.** A volume of brine of limited extent trapped within fractures and/or intergranular pore spaces of a host rock and usually pressurized relative to normal formation fluids. Such pockets may exist under various conditions of stress and solute concentration. Pressurized brine pockets have been observed in the Castile Formation in the Delaware Basin..

**Brushy Canyon Formation.** The basal unit of the Guadalupian Series or Delaware Mountain Group within the Delaware Basin. The formation is dominated by submarine channel sandstones with minor limestones and shales, and its structural features are indicative of deposition in agitated water. This formation terminates northward against the Bone Spring flexure at the basin margin.

**Bureau of Land Management.** An agency of the federal government, within the Department of the Interior, which among other land management duties, reviews environmental assessments, environmental impact statements, land acquisition procedures, and any other plans to site waste management facilities on federal lands over which it has jurisdiction.

**calcareous remnant.** Commonly used with reference to organisms that use calcium compounds to form endo- or exoskeletal structures. The calcareous remnant is that which remains after the soft tissues have disappeared.

**calcic.** Said of minerals and igneous rocks containing a relatively high proportion of calcium; the proportion required to warrant use of the term depends on circumstances.

**calcite.** A crystalline mineral composed of calcium carbonate ($CaCO_3$).

**calibrate.** To vary parameters of an applied computational model within a reasonable range until differences between observed data and computed values are minimized.

**caliche.** A calcareous material commonly found in layers on or within the surface of stony soils of arid or semiarid regions. It occurs in the form of gravels, sands, silts, and clays cemented together by calcium carbonate or as crusts at the surface of the soil.

**Cambrian.** The oldest period of the Paleozoic Era, and the corresponding system of rocks. It is subsequent to the Precambrian Period and followed by the Ordovician Period, between approximately 570 and 505 million years ago.

**canister.** As used in this document, a container, usually cylindrical, for remotely handled transuranic waste. The waste remains in this canister during and after burial. A canister affords physical containment but not shielding; shielding is provided during shipment by a cask.

**capillary pressure.** The difference in pressure across the interface between two immiscible fluid phases jointly occupying the interstices of a rock. It is due to the tension of the interfacial surface, and its value depends on the curvature of that surface.

**Capitan Limestone.** Also referred to as the Capitan Reef and/or Capitan Formation. The Capitan Limestone or Reef is a light colored, fossiliferous and vuggy limestone and breccia which almost completely surrounds the Delaware Basin. The reef was formed in the Early to Mid-Permian Period, between approximately 286 and 260 million years ago. It is a time-stratigraphic equivalent of the Bell Canyon Formation in the Delaware Basin. The reef is a major part of the Guadalupe Mountains from the west to the northwest of the WIPP site, the Apache Mountains and Davis Mountains to the south, and the Glass Mountains to the southeast.

**Capitan Reef.** See Capitan Limestone.

**carbonate mudstone.** A nonfissile mud shale consisting mainly of carbonate minerals.

**carbonates.** Compounds containing the carbonate radical, $CO_3^{-2}$, primarily applies to rock formations composed of carbonate minerals.

**Carlsbad potash district.** The area east of Carlsbad formally designated by the U.S. Geological Survey as having potentially economic grades of potash mineralization.

**carotenoid pigment.** A yellow-to-red color found in microbes and associated biofilms (plants and animals) observed in WIPP microbial gas generation experiments.

**cask.** A massive shipping container providing shielding for highly radioactive materials and holding one or more canisters.

**$CaSO_4$.** Calcium sulfate.

**Castile Formation.** A formation of evaporite rocks (mainly anhydrite with a few halite interbeds) of Permian age that immediately underlies the Salado Formation.

**catalytic surface.** Referring to a substance on a surface that initiates a reaction and enables it to take place at lower temperature or activation energy than in the absence of the catalyst.

**cation-anion.** A cation is a positively charged ion whereas an anion is a negatively charged ion. A cation in an electrolyzed solution migrates to the cathode (negative terminal); an anion in an electrolyzed solution migrates to the anode (positive terminal).

**cavings.** During rotary drilling, material that erodes from the borehole wall in response to the upward-flowing drilling fluid within the annulus formed by the drill pipe and the borehole wall.

**cellulosic.** Those materials derived from high polymer plant carbohydrates. Examples are paper, cardboard, wood, cellophane, cloth, etc.

**cementitious.** A mineral agent, natural or man-made, usually emplaced by hydration or exsolution, that serves to bind together grains of another material, thereby acting as or resembling cement. May also be used to describe a geologic deposit containing a significant amount of cementitious material that was formed by this mechanism.

**Cenozoic.** An era of geologic time, from the beginning of the Tertiary period to the present (Some authors do not include the Quatenary, considering it a separate era). It is characterized paleontologically by the evolution and abundance of mammals, advanced mollusks, and birds; paleobotanically, by angiosperms. The Cenozic is considered to have begun about 66 million years ago.

**Central Basin Platform.** The geological region known as the High Plains, covering an area of several hundreds of square miles separating the Delaware and Midland basins.

**certification.** Any action taken by the Administrator of the U.S. Environmental Protection Agency under Section 8(d) of the WIPP Land Withdrawal Act.

**certifier.** In the context of 40 CFR Part 191, the "certifier" is the U.S. Environmental Protection Agency, which must certify whether the Department of Energy has demonstrated that the Waste Isolation Pilot Plant is in compliance with the requirements of the standard.

**chelating agents.** A particular category of complexant that increases solubility by forming a cage around the complexed (or chelated) substance.

**chemical retardation.** Refers to retardation effects (see retardation) that are attributable to chemical mechanisms. Chemical reactions with constituents of a rock, precipitation, and sorption of contaminants are examples of chemical retardation.

**chemical source term.** The fraction of the hazardous constituents inventory that can be mobilized for transport.

**chemisorption.** The immobilization of a gas, liquid, or material in solution or suspension by the formation of bonds with the surface molecules of a solid material. The strength of these bonds is comparable to that of ordinary chemical bonds.

**Cherry Canyon Formation.** The center sandstone of the Delaware Mountain Group consisting of a fine-grained sandstone to siltstone that is very finely laminated.

**chert.** A hard, extremely dense or compact, dull to semivitreous, microcrystalline or cryptocrystalline sedimentary rock, consisting dominantly of interlocking crystals of silica ($SiO_2$) less than about 30 μm in diameter.

**chronostratigraphic boundaries.** The boundary of a rock stratum that is characterized by having been formed during a specific interval of geologic time.

**clastic sedimentation.** A sediment formed by the accumulation of fragments derived from preexisting rocks or minerals and transported as separate particles to their places of deposition by purely mechanical agents (such as water, wind, ice, and gravity).

**clastics.** Pertaining to a rock or sediment composed principally of broken fragments that are derived from preexisting rocks or minerals and that have been transported some distance from their places of origin; also said of the texture of such a rock. The term has been used to indicate sources both within and outside the depositional basin.

**Clayton Basin.** Northeast of the WIPP site by eight miles. It contains Quaternary alluvium.

**climate.** The average condition of the weather at a place over a period of years as exhibited by temperature, wind velocity, precipitation and other factors.

**climax vegetation.** The vegetation that would exist if an area was undisturbed.

**Code of Federal Regulations.** A codification of the general and permanent rules published in the Federal Register by the departments and agencies of the Federal government. The Code is divided into 50 titles that represent broad areas subject to Federal regulation. It is issued quarterly and revised annually.

**collapse block.** A gravity-induced collapsed rock unit resulting from the formation of sink holes.

**colloid.** Refers to a suspended particulate in a colloidal suspension or to a particle that is small enough that it could be placed in colloidal suspension. A colloidal suspension is a dispersion of extremely fine particles in a fluid with the characteristic size of the particles (in at least one dimension) being so small that the behavior differs from that of more common suspensions. The maximum size range for particles which may be regarded as "colloidal" is subject to some variation, depending on context and application.

***CCDFGF. The CCDFGF code assembles the release estimates from all other components of the WIPP Performance Assessment system to generate cumulative complementary distribution functions (CCDFs) of releases.***

**complementary cumulative distribution function.** Mathematically, a complementary cumulative distribution function is equal to one minus a cumulative distribution function. A cumulative distribution function is the sum (or integral) of the probability of those values or variables that are less than or equal to a specified value. Complementary

cumulative distribution functions are a graphical display of the probability (the ordinate) that the value of the variable will be greater than a specified value (the abscissa). For the WIPP, the complementary cumulative distribution function displays the probability that 10,000-year cumulative radionuclide releases from the disposal system for the scenarios considered will exceed calculated values. Radionuclide releases are normalized as stipulated in 40 CFR Part 191, Appendix A, and the complementary cumulative distribution function is compared to the quantitative release limits specified in 40 CFR § 191.13(a).

**complexing agents.** Complexing agents increase the solubility of the complexed substance; the aqueous solubility. They are often referred to as complexants.

**complexants.** Complexing agents increase the solubility of the complexed substance; the aqueous solubility. They are often referred to as complexing agents.

**compliance assessment.** The analysis conducted to determine compliance with the Individual Protection requirements in 40 CFR § 191.15 and the Groundwater Protection Requirements in Subpart C.

**computational model.** The computational model is the implementation of the mathematical model. (See definition of mathematical model below). The implementation may be through analytical or numerical means. Often, the analytical solution is numerically evaluated (for example, numerical integration or evaluation of complex functions); hence, both solution techniques are typically coded on the computer. Consequently, the computational model is often called a computer model.

**computer model.** A computer code or set of codes that are used together to make calculations for a corresponding mathematical description for a process or system (for example, movement of groundwater through a geologic formation).

**conceptual model**. A set of qualitative assumptions used to describe a system or subsystem for a given purpose. At a minimum, these assumptions concern the geometry and dimensionality of the system, initial and boundary conditions, time dependence, and the nature of the relevant physical and chemical processes. The assumptions should be consistent with one another and with existing information within the context of the given purpose.

**conductivity.** A material property describing the ease with which something can be transferred through that material. Examples of conductivity are electrical conductivity (electricity), thermal conductivity (heat transfer), or hydraulic conductivity (groundwater flow).

**confirmation.** For the purposes of this document, a term used to indicate support or establishment of certainty and/or validity of models used in reference to specific performance issues of the repository over any specific time frame of interest. In general, laboratory and field experiments at the WIPP and elsewhere are conducted to provide data in support of this type of activity, such as for the gas generation model.

Confirmation is used in a mechanistic sense and is not intended to have specific legal implications.

**consequence analysis.** The analysis used to examine the effects of processes and events on performance of the disposal system. (See Performance Assessment).

**conservative assumption.** Assumptions that result in the overestimation (rather than underestimation) of any phenomenon that could contribute to the release of radionuclides from the disposal system.

**Consultation and Cooperation Agreement.** An agreement that affirms the intent of the Secretary of Energy to consult and cooperate with the State of New Mexico with respect to State public health and safety concerns. The term "Agreement" means the July 1, 1981, Agreement for Consultation and Cooperation, as amended by the November 30, 1984, "First Modification," the August 4, 1987, "Second Modification," and the March 22, 1988, modification to the Working Agreement.

**contact-handled transuranic waste.** Packaged transuranic waste that has a measured external surface dose rate less than 200 millirems per hour at the surface of the container.

**containment.** The retention of radioactivity within prescribed boundaries, such as within a waste package. In this document, containment refers to retention within a system to prevent releases in unacceptable quantities or concentrations during handling and storage, or to containment within the disposal system.

**contamination.** Introduction of radionuclides into the repository's immediate surroundings, such as into the brine via a breach of the containment system.

**controlled area.** The controlled area means (1) a surface location, to be identified by passive institutional controls, that encompasses no more than 100 square kilometers and extends horizontally no more than 5 kilometers in any direction from the outer boundary of the original location of the radioactive wastes in a disposal system; and (2) the subsurface underlying such a surface location. (40 CFR § 191.12). For WIPP, the controlled area is defined by the area withdrawn by the Land Withdrawal Act.

**convection.** The circulatory motion that occurs in a fluid at a nonuniform temperature. The transfer of heat by automatic circulation of fluids.

**corrosivity.** The tendency of a metal to deteriorate by chemical decomposition.

**creep.** A very slow, usually continuous, time-dependent movement of soil or rock; refers to the geologic phenomenon experienced as the gradual flow of salt under differential stress.

**creep closure.** Closure of underground openings, especially openings in salt, by plastic flow of the surrounding rock under lithostatic pressure.

**Cretaceous.** The final period of the Mesozoic era (after the Jurassic and before the Tertiary period of the Cenozoic era), thought to have covered the span of time between 135 and 66 million years ago; also, the corresponding system of rocks. It is named after the Latin word for chalk (creta) because of the English chalk beds of this age.

**crustal processes.** Any processes that occur within the earth's crust. Usually refers to igneous, metamorphic, or tectonic activity.

**crystallographic.** This term deals with the system of forms among crystals, their structures, and their physical properties.

**CSH gel.** A cementitious material containing calcium-silicate-hydrate gel.

**cubic law.** The cubic law states that for a given change in gradient of the hydraulic head, flow through a fracture is proportional to the cube of the fracture opening.

**cuesta.** A hill or ridge with a gentle slope on one side and a steep slope on the other, specif. an asymmetric ridge (as in the southwest United States) with one face (dip slope) long and gentle and conforming with the dip of the resistant bed or beds that form it, and the opposite face (scarp slope) steep or even cliff-like and formed by the outcrop of the resistant rocks, the formation of the ridge being controlled by the differential erosion of the gently inclined strata.

**Culebra.** The Culebra Dolomite Member, also referred to as Culebra, is the lower of two rock units of dolomite within the Rustler Formation and was formed in the late Permian Period between approximately 258 and 245 million years ago. It is a brown, finely crystalline, argillaceous dolomite or dolomitic limestone with solution cavities. The Culebra is the principal water-bearing unit of the Rustler Formation and has been identified as the most likely pathway for release of radionuclides to the subsurface accessible environment.

**cultural resource sites.** Human-associated ruins of archaeological significance.

**Cumulative Distribution Function.** A cumulative distribution function is the sum (or integral) of the probability of those values of variable that are less than or equal to a specific value.

**curie.** A quantitative measure of radioactivity equal to $3.7 \times 10^{10}$ disintegrations per second.

**curie load.** The number of curies in a particular location or in a container such as a radioactive waste drum. The curie load of a waste drum may be broken down into alpha, beta, and gamma curie loads to describe the amount of total radioactivity that is contributed by disintegrations yielding alpha, beta, or gamma radiation.

**cuttings.** During rotary drilling, material contained in the cylindrical volume created by the cutting action of the drill bit. In terms of releases from the WIPP through inadvertent human intrusion, the maximum potential waste volume that could form cuttings is equal to the cross-sectional area of the drill bit multiplied by the repository thickness.

***CUTTINGS_S. The CUTTINGS_S code was written to calculate the quantity of material (in $m^3$) brought to the surface from a radioactive waste disposal repository as a consequence of an inadvertent human intrusion through drilling.***

**Darcy's Law.** A mathematical equation that can be used to compute the quantity of water flowing through an aquifer. $Q = KA(h_A - h_B/L)$. Q is the discharge, A is the cross-sectional area, $h_A - h_B$ is the difference in the height of the water (hydraulic head), L is the flow length, and K is a coefficient, which is dependent upon the nature of the porous medium.

**daughter product.** A nuclide that results from radioactive decay. Thus radium-226 decays to radon-220, which in turn decays to polonium-216. The radon is the daughter of the radium, and the polonium is the daughter of the radon.

**Davis Mountains.** A mountain range in Texas south of the WIPP site making up the southern-most part of the Capitan Reef.

**decay, radioactive.** The decrease in the number of radioactive nuclei present in a radioactive material due to their spontaneous transmutation. Also, the transmutation of a radionuclide into another nuclide by the emission of a charged particle.

**decommissioning.** Actions taken upon closure of the repository to reduce potential environmental, health, and safety impacts, including repository sealing as well as activities to stabilize, reduce, or remove radioactive materials or demolish surface structures.

**decommissioning phase.** The term "decommissioning phase" refers to the period of time beginning with the end of the disposal phase and ending when all shafts at the WIPP repository have been sealed.

**decontamination.** With respect to operational activities, decontamination is the removal of unwanted material (especially radioactive material) from the surface of or from within another material.

**defense waste.** Nuclear waste deriving from the manufacture of nuclear weapons and the operation of naval reactors. Associated activities, such as the research carried on in the weapons laboratories, also produce defense waste.

**deformation.** Any change in the original form or volume of rock masses. Folding, faulting, solid flow, and dissolution and subsequent collapse are examples of deformation.

**degradation.** The wearing down or away of a material or the earth's surface, whether on a large or small scale, and the products it produces. Examples of degradation include the wearing down of drill casing from corrosion, and the wearing down of organics in the waste materials from microorganisms.

**Delaware Basin.** Those surface and subsurface features that lie inside the boundary formed to the north, east, and west of the disposal system by the innermost edge of the Capitan Reef, and formed to the South by a straight line drawn from the southeastern point of the Davis Mountains to the most southwestern point of the Glass Mountains.

**Delaware Mountain Group.** A set of three formations that underlie the Castile Formation at the Los Medaños site. The uppermost of these is the Bell Canyon Formation.

**demography.** The statistical study of human population with response to sizes and density, distribution, and vital statistics.

**density.** Mass per unit volume (that is, kilograms per cubic meter).

**denudation.** The sum total of processes that results in the general lowering of the land surface.

**Design Basis Earthquake.** An earthquake that is the most severe design basis accident of this type and that produces the vibratory ground motion for which safety class items are designed to remain functional.

**Design Basis Tornado.** A tornado that is the most severe design basis accident of that type applicable to the area under consideration.

**detritivores.** Organisms that eat organic debris.

**deviatoric stress.** Refers to a state of stress disequilibrium in the subsurface, in which at least one of the three perpendicular (normal) axes used to characterize stress at a point differs in magnitude from the other two. The stress tensor used to characterize subsurface stress can be written as the sum of two tensors. The first tensor represents a hydrostatic state with all shear stresses equal to zero. The components of the second tensor are shear stresses - these are deviatonic stresses and are independent of hydrostatic stress.

**Devonian.** A period of the Paleozonic Era (after the Silurian and before the Mississippian) spanning the time between 400 and 345 million years ago; also, the corresponding system of rocks. It is named after Devonshire, England, where rocks of this age were first studied.

**Devonian Woodford Shale.** This is a Devonian-age geological marker about 15,600 feet deep at the WIPP that separates rocks of the Silurian era from rocks of the Mississippian era.

**Dewey Lake Redbeds.** A formation of the Permian Period that overlies the Rustler Formation and is composed of reddish brown marine mudstone and siltstones interbedded with fine grained sandstone.

**diapirism.** The formation of an intrusion or diapir that penetrates through overlying layers of more brittle rock and domes the overlying rock cover. Diapirs are commonly formed

from mobile igneous intrusions or from plastic salt bodies. The development of narrow necks at depth often gives diapirs a balloon-like form.

**diagenetic.** Pertaining to or caused by diagenesis; for example, a "diagenetic change" resulting from compaction, a "diagenetic structure" (such as a stylolite) formed after deposition, a "diagenetic deposit" (such as dolomitized limestone or consisting of manganese nodules), or a "diagenetic environment" of rock consolidation.

**diffusion, molecular.** Transport of material (particularly the spread of a contaminant) through the random motion of molecules in a fluid or solid. Diffusion results in the slow transfer of material from regions of high concentration to regions of lower concentration even when there is no net fluid flow.

**dike.** A tabular body of igneous rock that cuts across the structure of adjacent rocks or cuts massive rocks. Most dikes result from the intrusion of magma. Some dikes occur in a set of numerous parallel structures identified as dike swarms. Present in the vicinity of the WIPP site are lamprophyre dikes. (See Lamprophyre)

**discharge point (or area).** In groundwater hydraulics, the point (or area) where water comes out of an aquifer onto the surface.

***Disposal Inventory. The inventory volume defined for waste emplacement in the WIPP to be used for CRA-2004 PA calculations. The Land Withdrawal Act (LWA; Public Law 102-579) identifies the total amount of TRU waste allowed in the WIPP as 175,564 $m^3$ (6,200,000 $ft^3$). The "Agreement for Consultation and Cooperation" limits the RH-TRU inventory to 7,079 $m^3$ (250,000 $ft^3$).***

**dispersion.** Signifies the tendency for a sharp change in fluid properties (for example, temperature, contaminant concentration) to become broader and less abrupt as flow progresses. For example, if a volume of contaminated water is injected into an aquifer, the contact between the contaminated and uncontaminated water will initially be sharply defined by a very steep gradient in contaminant concentration. As the water flows away from the injection point, however, natural variations in the rock allow contaminated water to move quickly through some large pores while nearby smaller pores will retain uncontaminated water for a longer period. This, and other similar effects, will cause contaminated and uncontaminated water to intermingle, resulting in dispersion of the contaminant "front."

**disposal.** The term "disposal" means permanent isolation of transuranic waste from the accessible environment with no intent of recovery, whether or not such isolation permits the recovery of such waste. Disposal of waste in a mined geologic repository occurs when the waste has been emplaced and all the shafts to the repository are sealed.

**disposal phase.** The term "disposal phase" means the period of time during which transuranic waste is disposed of at the WIPP, beginning with the initial emplacement of transuranic

waste for disposal and ending when the last container of transuranic waste is emplaced for disposal and the shafts are sealed.

**disposal room.** An excavated cavity in the WIPP repository in which transuranic waste will be emplaced during disposal operations.

**disposal system.** The disposal system is any combination of engineered and natural barriers that isolate transuranic waste after disposal. For the purposes of the WIPP, this will include the combination of the repository/shaft system and the controlled area.

**disposal system performance.** Disposal system performance is measured in Section 6.5. It is compared with the EPA requirements in the complementary cumulative distribution function.

**dissolution.** (1) The process whereby a space or cavity in or between rocks is formed by the solution of part of the rock material. (2) The solution of material by a solvent (for example, dissolution of waste by brine at the WIPP).

**disturbed rock zone.** That portion of the geologic barrier in which the physical and/or chemical properties may have changed significantly as a result of underground construction activities.

**Dockum Group.** The Triassic Dockum Group consists of three formations. In ascending order, they are (1) the Tecovas Formation, which consists of up to 300 ft of red shale, siltstone, and fine-grained sandstone; (2) the Santa Rosa Sandstone, which is composed of 100 to 650 ft of red, brown, and gray sandstone; and (3) the Chinle Formation equivalent, which consists of up to 1,300 ft of red, maroon, and purple shales and siltstones with lenses of fine-grained red-to-gray sandstone. The group is present only as a thin wedge in Eddy County, thickening to the east in Lea County and in Texas.

**dolomite.** A sedimentary rock consisting mostly of the mineral dolomite: $CaMg(CO_3)_2$. It is commonly found with limestone.

**dome (breccia pipe).** A type of hill found near the Los Medaños site; under at least a few of these hills lies a roughly cylindrical volume of breccia (rock reconstituted of coarse rock fragments).

**dome, salt.** A diapiric or piercement structure with a central, nearly circular salt plug, generally 1 to 2 km in diameter, that has risen through the enclosing sediments from a deep mother bed of salt. In the continental U.S., salt domes are located primarily in the Gulf Coast states.

**dose.** A general term indicating the amount of energy absorbed per unit mass from incident radiation.

**dose conversion factor.** A numerical factor used in converting radionuclide uptake (curies) in the body to the resultant radiation dose or dose commitment (rem or man-rem).

**dose equivalent.** The product of absorbed dose and appropriate factors to account for differences in biological effectiveness due to the quality of radiation and its spatial distribution in the body; the unit of dose equivalent is the rem (sievert in System of International units). (40 CFR § 191.12)

**downdip.** To move in the direction at which a rock layer or any planar feature is inclined (dip) from the horizontal.

**drift.** A horizontal passageway in a mine away from the main shaft.

**drilling fluids.** A suspension fluid used in drilling. The fluid is pumped through the inside of the drill pipe and out through the jets of the drilling bit. It is used to lubricate the drilling bit, seal off porous zones, and to counter-balance the pressure of oil, gas, or water. The fluids consist of various substances in a finely divided state among which bentonite and barite are common. Oil may also be used as a base instead of water.

**Driving Force Ratio.** A ratio established to assess the effects of density gradient when examining hydraulic effects of fluid density variations in the Salado interbeds and the Culebra. It is given by driving force ratio = $(\Delta\rho\rho\ \nabla E)/(\rho f\ \Delta Hf)$, where $\Delta Hf$ is the gradient of freshwater head, $\Delta\rho$ is the difference between actual fluid density and reference fluid density, $\rho f$ is the density of freshwater, and $\nabla E$ is the gradient of elevation.

***DRSPALL. The DRSPALL code is written to calculate the spallings release, defined as a mass of waste subject to tensile failure during an inadvertent drilling intrusion into a high-pressure WIPP repository.***

**E1, E2.** These are potential human intrusion scenarios used in computer modeling for compliance purposes.

**effective dose.** The sum over specified tissues of the products of the dose equivalent received following an exposure of, or an intake of radionuclides into, specified tissues of the body, multiplied by appropriate weighting factors. This allows the various tissue-specific health risks to be summed into an overall health risk. The method used to calculate effective dose is described in Appendix B of 40 CFR Part 191. (40 CFR § 191.12)

***effective porosity. Porosity is defined as the ratio of volume to bulk volume. Effective porosity is connected porosity, through which fluids may move; that is, it has permeability.***

**effluent.** Wastewater or airborne emissions discharged into the environment.

**Eh.** The oxidation potential is a measure of the oxidizing or reducing tendency of a solution. It is written as a reduction reaction using the standard hydrogen reaction, Eh (volts) = $E_h^0$ + RT/nF ln (oxidized species/reduced species).

**elasticity.** The ability of rocks to recover in size and shape (no long-term changes in rock properties) resulting from minor deformation (for example, minor deflection of anhydrite beds, deformation of rock due to passage of seismic wave, etc.). The property by virtue of which a body resists and recovers from deformation produced by force.

**electrochemical.** Refers to chemical effects or reactions that produce, are mediated by, or significantly influenced by electrical currents or accumulations of electrical charge.

**electrolytes.** A substance that will provide ionic conductivity when dissolved in water or when in contact with water. The term is also used to designate solutions of such substances.

**electromechanical.** Mechanical processes or effects that are driven by or produce electricity.

**electron acceptors.** Atoms or molecules that will readily accept an additional electron to form an ionic or covalent bond. The availability of such chemical species is necessary for some bacterial processes involving the decomposition of complex organic molecules.

**electrophoresis.** Migration of colloidal or other particles in a liquid suspension that responds to applications of an electric field.

**empirical.** Methods that rely on experience or observation alone without regard for system and theory. They are capable of being verified or disproved by observation or experiments.

**emplacement.** At the WIPP, the placing of radioactive wastes in the repository.

***Emplaced Waste Inventory. Waste that has been disposed at the WIPP as of the inventory date (September 30, 2002).***

**engineered alternatives.** Potential modifications to the design or operation of the WIPP or to waste forms that, if adopted, will provide increased assurance that the WIPP will perform in compliance with environmental protection and safety requirements.

**engineered barriers.** Backfill, seals, and any other man-made barrier components of the disposal system.

**enthalpy.** The sum of the internal energy (heat) generated or absorbed when a reaction takes place.

**eolian.** Pertaining to the wind. Also spelled aeolian.

**EPA unit**. The EPA unit is a measure of radioactivity that has been normalized by the inventory of the disposal system in question and by the release limits specified by the EPA in

Appendix B, Table 1, of 40 CFR Part 191. Specifically, a quantity of radioactivity of any radionuclide (expressed in curies) may be expressed in dimensionless EPA units by dividing it by the product of the waste unit factor and the EPA release limit for that radionuclide. The containment requirements of 40 CFR § 191.13(a) establish release limits for the disposal system in terms of the probability that 10,000 year cumulative releases will exceed 1 and 10 EPA units.

***EPAUNI. The EPAUNI code is used for estimating the probability distribution of EPA unit loading in the WIPP repository.***

**epicenter.** The point on the earth's surface directly above the focus of an earthquake.

**equilibrium.** A state of balance between opposing forces or actions that is either static (as in a body acted on by forces whose resultant is zero) or dynamic (as in a reversible chemical reaction when the velocities in both directions are equal).

**erosion.** The processes whereby earthy or rock material is loosened or dissolved and removed from any part of the earth's surface. It includes the processes of weathering, solution, corrosion, and transportation.

**estuarine.** The seaward end of the widened tidal mouth of a river where fresh water comes into contact with seawater.

**evaporite.** A sedimentary rock composed primarily of minerals produced by precipitation from a solution that has become concentrated by the evaporation of a solvent, especially salts deposited from a restricted or enclosed body of seawater or from the water of a salt lake. In addition to halite (NaCl), these salts include potassium, calcium, and magnesium chlorides and sulfates.

**event.** A phenomenon that occurs instantaneously or within a short time interval relative to the time frame of interest.

**excavation.** The action of cutting, digging, or mining a cavity in the earth and the removal of that mined material. The WIPP repository excavated in solid salt rock is an example of excavation.

**exothermic.** The release of heat from a (chemical) reaction.

**extraction.** The withdrawal of natural resources with no provision for replenishment.

**fast Langrangian analysis of continua.** A two-dimensional finite-difference code used for the WIPP to estimate subsidence above the repository for conditions ranging from no backfill to emplacement of a highly compacted crushed salt backfill.

**fault.** A surface or zone of rock fracture along which there has been displacement.

**fault tree.** A tree-like cause-and-effect diagram of hypothetical events. Analysis of fault trees is used to investigate failures in a system or concept.

**fauna.** An entire animal population of a given region, environment, formation, or time span.

**features, events, and processes.** Features, events, and processes (FEPs) that are potentially important to long-term performance of the disposal system. A comprehensive set of FEPs relevant to the WIPP was considered in applying a screening methodology to evaluate compliance with the numerical performance requirements provided in 40 CFR Part 191.

**Federal Facilities Compliance Act.** An amendment, promulgated in 1992, to the Solid Waste Disposal Act. Title I of the act grants the EPA administrative enforcement authority against any department, agency, or instrumentality of the executive, legislative, or judicial branch of the federal government. In regard to mixed wastes, sovereign immunity for federal agencies is waived, consistent with a schedule provided in the act. In addition, the act requires that the DOE prepare an inventory of mixed wastes and mixed waste treatment capacities and technologies. For those mixed wastes for which treatment capacities or technologies do not exist, the Department must prepare plans for the development of the capacities or technologies.

**Fick's Law.** Mathematical equation in which steady-state diffusion through solids is represented. J is the flux or diffusion current density, D is the diffusion coefficient, c is the volume concentration of atoms, and x is the distance along the direction in which diffusion occurs.

**filter bank.** An arrangement of air filters in series and/or parallel.

**final safety analysis report.** A safety document providing a concise but complete description and safety evaluation of the site, the design, normal and emergency operations, potential accidents, and predicted consequences of such accidents, and the means proposed to prevent such accidents or to mitigate the consequences of such accidents. A final safety analysis report documents the adequacy of safety analysis for a nuclear facility to ensure that the facility can be constructed, operated, maintained, shut down, and decommissioned safely and in compliance with applicable laws and regulations.

***Final Waste Form. The expected physical form of a waste stream. The use of the final waste form helps to group waste streams that are expected to have similar physical and chemical properties at the time of disposal. Waste is assigned to one of 11 final waste forms: solidified inorganics, salt, solidified organics, soils, uncategorized metal, lead/cadmium metal, inorganic non-metal, combustible, graphite, heterogeneous, and filter.***

**fissile material.** Fissile material means any material consisting of or containing one or more fissile radionuclides. Examples of fissile radionuclides are plutonium-238, plutonium-239, plutonium-241, uranium-233, and uranium-235.

**fission.** The splitting of a heavy nucleus into two approximately equal parts, each the nucleus of a lighter element, accompanied by the release of a large amount of energy and generally one or more neutrons. Fission can occur spontaneously, but it usually follows the absorption of neutrons.

**fissionable.** A nuclide that is available to undergo fission on absorption of a neutron with energy over some threshold energy.

**flowpath.** The path traveled by a zero-charged, floating particle released into a groundwater flow field.

**fluid.** A substance that is able to flow freely as liquids and gases do.

**fluvial.** Produced by or pertaining to a river or rivers. Applies to erosion (fluvial erosion) by rivers or streams and deposition (fluvial deposition) by the accumulation of sediments in a depositional environment associated with rivers or streams.

**flux.** The rate of transfer of heat, mass, electricity, groundwater, etc., across a unit surface area in a unit time.

**formation (geologic).** The basic rock-stratigraphic unit in the local classification of rocks. It consists of a body of rock (usually sedimentary) generally characterized by some degree of internal lithologic homogeneity or distinctive features.

**Forty-niner Member.** Upper most member of the Rustler Formation formed in the Late Permian Period, between approximately 250 and 245 million years ago. It consists of upper and lower sulfates separated by claystone or halite. The member is about 60 ft (18 m) thick around the WIPP site.

**fracture porosity.** Porosity resulting from the presence of openings or fractures produced by the breaking or shattering of an otherwise less porous rock.

**fractures.** A general term for any break in a rock, whether or not it has an associated displacement. Fractures are the result of mechanical failure by stress. Fractures include cracks, joints, and faults. Fracture porosity is the resulting opening produced by the breaking or shattering of an otherwise less pervious rock.

**fugacities.** The pressures of vapors assumed to behave as ideal gases.

**galvanic coupling.** Refers to the establishment of an electrical current through chemical processes. Galvanic coupling could lead to the establishment of potential gradients between metals in the waste form, canisters, and other metals external to the waste form.

**gamma rays.** (X-rays) Short wavelength electromagnetic radiation emitted in the radioactive decay of certain nuclides. Gamma rays are the same as gammas or gamma particles.

**gas generation.** Three gas generation processes are expected to be factors in the degradation of transuranic waste in the WIPP repository. The generation of gaseous species is expected to occur through chemical (that is, corrosion), microbial, and radiolytic processes.

**gas generation model.** A computational model that can simulate and/or predict the rate and quantity of gases generated by waste transformation processes in a disposal room of the decommissioned repository.

**gas generation rate.** The combined gas production rate from all species of gases produced as a result of transuranic waste transformations such as corrosion, and/or microbial degradation, at any given time. The rate of gas production throughout the history of the repository is expected to vary depending on repository conditions with respect to humidity, total or partial brine inundation, competitive reactions that absorb specific gases, and the ability of the repository to retain the gases generated. The term is also applied to individual gases.

**gastropod.** Any of a large class (Gastropoda) of mollusks with a univalve shell or none, usually with distinct head-bearing sensory organs.

**Gatuña Formation.** A geologic formation covering the Permian Dewey Lake Formation, or the Santa Rosa Formation of the late Pliocene Period. Considered to be fluvial in origin, the Gatuña Formation varies in thickness and is overlain by the Mescalero Caliche.

**generator and/or storage sites.** Refers to the DOE sites nationwide where transuranic wastes are generated and/or stored as a result of activities associated with nuclear weapons production.

**geochemistry.** The study of the relative and absolute abundances of elements found on the earth, and the chemical distribution and migration of individual elements located in various parts of the earth (the atmosphere, hydrosphere, etc.).

**geomechanical.** The response of natural earth materials to the application of deforming forces. These forces would include the excavation and subsequent deformational response of the WIPP disposal rooms and drifts.

**geomorphology.** The description and interpretation of landforms on the earth's surface.

**geophysical log.** A graphic record of the measured or computed physical characteristics of the rock section encountered in a well, plotted as a continuous function of depth. Measurements are made by a sonde as it is withdrawn from the borehole by a wireline. Several measurements are usually made simultaneously, and the resulting curves are displayed side by side on the common depth scale. Both the full display and the individual curves are called logs. Well logs are commonly referred to by generic type.

**geophysical techniques.** The methods used to obtain geophysical data (that is, values of the physical parameters of the earth). The methods of techniques generally involve the study of ambient fields (gravitational, magnetic, electrical, temperature) or the study of the effects of applied fields (seismics through the application of shock waves, electrical through the direct application of electrical currents — resistivity methods — and by electromagnetic induction.)

**geostatistics.** A branch of statistics used to describe and interpret spatial data.

**geothermal.** The internal energy of the earth, available from heat sources produced at depth within the earth's crust.

**getters.** Substances that sorb gases, such as carbon dioxide ($CO_2$), and may be added with other materials to mitigate the pressure buildup in the repository and radionuclide mobility.

**Gibbs Free Energy.** A thermodynamic quantity defined as H - TS. H is enthalpy, S is absolute entropy, and T is temperature. The magnitude of the change in Gibbs Free Energy for a reaction determines whether it is reversible or will occur spontaneously at given temperature and pressure.

**glaciation.** Applies to both the formation, progression, and recession of glaciers and the resulting alteration of the earth's ground surface through erosion and deposition.

**glove box.** A sealed box in which workers, remaining outside and using gloves attached to and passing through openings in the box, can safely handle and work with radioactive materials under controlled conditions.

**Goat Seep.** The Goat Seep was a reef that grew primarily upward and formed a barrier around a considerable portion of the western side of the Delaware Basin. The lower portion of the Goat Seep is thick-bedded, and the upper portion is a massive light gray, fine-crystalline to saccharoidal, and in places very porous, dolomite.

**graben.** An elongate, relatively depressed crustal unit or block that is bounded by roughly parallel faults on its long sides. It is a structural form that may or may not be geomorphologically expressed as a rift valley.

**gradient.** Spatial changes in the value of a variable. Changes are along vertical, inclined, or horizontal distances, such as the groundwater pressure gradient of the Culebra Dolomite changing in the vicinity of the WIPP site.

**greenhouse effect.** Warming of the earth's surface and the lower layers of atmosphere that tends to increase with increasing atmospheric carbon dioxide and other gases, and is caused by conversion of solar radiation into heat.

**groundwater.** Water below the land surface in a zone of saturation. (40 CFR § 191.12)

**grout.** A mortar of cement slurry (of high water content) used to plug potential fluid-flow paths in geologic or engineered structures.

**Guadalupian.** Geological group of rocks below the Castile about 4,100 ft to about 8,000 ft below the surface at the WIPP. Contains the Bell Canyon, Brushy Canyon, and Cherry Canyon formations.

**gypsite.** An earthy variety of gypsum containing dirt and sand, found only in arid regions.

**gypsum.** A mineral consisting of hydrous calcium sulfate: $CaSO_4 \$ 2H_2O$. It is soft and, when pure, white.

**half-life.** The time required for the activity of a group of identical radioactive nuclei to decay to half its initial value. (See biological half-life).

**halite.** The mineral rock salt: NaCl.

**halophilic.** A type of organism that flourishes in a salty environment, such as salt lakes and marshes. Halophilic microorganisms may be present in WIPP's disposal environment at the time of closure.

**halotolerant.** A type of organism that is tolerant of salty environments but does not prefer them. Halotolerant microorganisms may be introduced into the waste before disposal from semi-salty environments, such as the skin of humans.

**health physics.** The science concerned with the recognition, evaluation, and control of health hazards from ionizing radiation.

**heavy metal.** All uranium, plutonium, or thorium placed into a nuclear reactor. (40 CFR § 191.12)

**HEPA filter.** A high-efficiency particulate air filter usually capable of 99.7 percent efficiency as measured by a standard photometric test using 0.3-micron droplets (aerodynamic equivalent diameter) or dioctylphthalate.

**high-level waste.** Radioactive waste resulting from the reprocessing of spent fuel. Discarded, unreprocessed spent fuel is also high-level waste. It is characterized by intense, penetrating radiation and by high heat-generation rates. Even in protective canisters, high-level waste must be handled remotely.

**horizon.** In geology, an interface indicative of a particular position in a stratigraphic sequence. For instance, the waste-emplacement horizon in the Salado Formation at the WIPP is the level about 650 m (2,150 ft) deep where openings are mined for waste disposal.

**host rock.** The rock unit, in this case the Salado Formation, in which the radioactive waste is to be emplaced.

**hot cell.** A heavily shielded compartment in which highly radioactive material can be handled, generally by remote control.

**human intrusion.** (See Inadvertent Human Intrusion).

**humics.** Matter that is derived from humus, which is a brown or black complex of variable material resulting from partial decomposition of plant or animal matter and forming the organic portion of soil.

**hummocky.** Containing rounded knolls or small hills.

**hydration.** The uptake of water by a substance, generally involving reactions in which the H-OH bond of the water molecules is not broken. (See hydrolysis.)

**hydraulic conductivity.** A quantity defined in the study of groundwater hydraulics that describes the ability of rock to transmit groundwater. It is measured in feet per day or equivalent units. It is equal to the hydraulic transmissivity divided by the thickness of the aquifer.

**hydraulic gradient.** A quantity defined in the study of groundwater hydraulics that describes the rate of change of hydraulic head with distance.

**hydraulic potential (or hydraulic head).** Hydraulic pressure corrected for the potential energy of elevation. In an aquifer it is equivalent to the highest level of a column of water that the pressure in the aquifer will support. It is measured relative to a specified level, which in this document is the mean sea level.

**hydraulic transmissivity.** A rate at which water is transmitted through a unit width of aquifer. It is measured in square meters per second or equivalent units. (See transmissivity).

**hydraulic transport.** The transport of dissolved or suspended substances by groundwater.

**hydraulics, hydrology.** These two terms tend to be used interchangeably, but they are not the same. Hydraulics is an engineering discipline; hydrology is the related science. Hydraulics deals with the flow of water. Hydrology deals with water: its properties, circulation, and distribution, from the time it falls as rainwater until it is returned to the atmosphere through evapotranspiration or flows into the ocean.

**hydrocarbon.** An organic compound (as acetylene or benzene) containing only carbon and hydrogen and often occurring in petroleum, natural gas, coal, and bitumens.

**hydrolysis.** A chemical reaction between water and another material in which two or more new species are formed, implying that the H-OH bond in the water molecules is broken.

**hydrostatic.** The pressure and equilibrium of liquids such as the pressure exerted by water at any given point in a body of water at rest. The hydrostatic pressure of groundwater is generally due to the weight of water in higher levels in the zone of saturation.

**igneous.** Rocks that are formed by solidification from a molten or partially molten state. For convenience, igneous rocks are divided into two major classes, plutonic and volcanic, which describe igneous rocks formed at depth and at or near the land surface, respectively.

**inadvertent human intrusion.** The accidental violation of the disposal system through human activity such as mining or exploration drilling. Inadvertent and intermittent intrusion by drilling for resources (other than those resources provided by the waste in the disposal system or engineered barriers designed to isolate such waste) is the most severe human intrusion scenario (40 CFR § 194.33[b][1]).

**infiltration.** The penetration of water through the ground surface into subsurface soil.

**ingestion.** The uptake of materials taken into the body by way of the digestive tract.

**ingrowth.** The process in which a nuclide results from the radioactive disintegration of a radionuclide. The nuclide can be formed directly or as the results of successive transformations in a radioactive series. A decay product may be either radioactive or stable.

**injection well.** A well into which fluids are injected.

**in situ.** In the natural or original position. The phrase is used in this document to distinguish in-place experiments, rock properties, and so on, from those measured in the laboratory.

**insoluble.** Unable to be dissolved.

**intensity, earthquake.** A measure of the effects of an earthquake on humans and structures at a particular place. Not to be confused with magnitude.

**interbed.** A usually thin layer of rock, typically of one kind of rock material, occurring between or alternating with layers of another rock type. The Salado Formation in the vicinity of the WIPP site contains layers of anhydrite that are interbedded between more massive layers of halite.

**interfacial energy.** Energy associated with an interface between two materials (surfaces). Changes in interfacial energy control effects such as the wetting of a solid surface by a liquid.

**intergranular.** The porosity or spaces occurring between the grains of granular or crystalline rocks in which the void space usually contains a liquid.

**interpreted data sets.** Data sets derived from a surrogate data source where direct measurement is not possible.

**interstitial brine.** Brine distributed in the pore space (voids) of a rock mass.

**intragranular.** The porosity or spaces occurring within a grain or crystal, especially within skeletal material of a carbonate sedimentary rock in which the void space may or may not contain a liquid.

**intraplate rifting.** Rifting of the continental or oceanic crust within a crustal plate. Typically applies to areas that have shown regional extensional tectonic activity away from the plate boundaries and where igneous rocks have formed intrusive sill, dikes, volcanic plugs, and other intrusive bodies. Intraplate rifting has taken place along the Rio Grande valley, 120 miles (200 kilometers) west of the WIPP site during the Tertiary and Quaternary Periods. (See Rio Grande Rift).

***Inventory Date. September 30, 2002. The cutoff date for determining the emplaced waste inventory is included in CRA-2004 and the date TRU waste sites have used as the basis for their revised stored waste and projected waste inventory estimates.***

**ion exchange.** A phenomenon in which chemical species in one phase or material exchange with similar species in another phase.

**isopach.** A line drawn on a map through points of equal true thickness of a designated stratigraphic unit or group of stratigraphic units.

**isotope.** Any of two or more species of atoms of a chemical element with the same atomic number but with differing atomic mass.

**Jurassic.** The second period of the Mesozoic era (after the Triassic and before the Cretaceous), thought to have covered the span of time between 190 and 135 million years ago; also, the corresponding system of rocks.

**K-Ar.** Determination of the age of a mineral or rock in years, based on measurement of the ratio of radiogenic argon-40 to potassium-40 and the known radioactive decay rate of potassium-40 to argon-40.

**karst.** A type of topography that is formed on limestone, gypsum, and other rocks by dissolution, and that is characterized by sinkholes, caves, and underground drainage.

**$K_d$.** A symbol used to designate a coefficient used in calculating chemical retardation.

**kelvin.** The name of the absolute temperature scale generally used in scientific measurements and calculations. The unit of temperature is also designated a kelvin.

**kinetic.** An adjective referring to motion and, by extension, to changing conditions. In chemistry, kinetic behavior refers to the performance of a system in which ongoing chemical reactions are changing the quantities or character of the substances present in the system at a certain rate and are thereby moving towards equilibrium.

**lacustrine.** The term is used to identify sediments formed by deposition in lakes and to identify chemical and biological processes that typically occur in lakes.

**Lamar Limestone.** A limestone member at the top of the Bell Canyon Formation, known as the Lamar limestone, is recognizable over a considerable part of the Delaware Basin.

**lamprophyre.** A group of dark-colored intermediate igneous rocks characterized by unrestricted crystal structures and a high percentage of mafic minerals (that is, biotite, hornblende, and pyroxene). Lamprophyre igneous rocks commonly occur in the form of dikes. (See Dike) This type of dike is present in the vicinity of the WIPP site and is identified by the dark minerals that occur both as phenocrysts and in the groundmass and light minerals occurring only in the groundmass.

**Land Withdrawal Act.** Public Law 102-579, which withdraws the land at the WIPP site from "entry, appropriation, and disposal," transfers jurisdiction of the land from the Secretary of the Interior to the Secretary of Energy, reserves the land for activities associated with the development and operation of the WIPP, and includes many other requirements and provisions pertaining to the protection of public health and the environment.

**langbeinite.** A mineral, $K_2Mg_2(SO_4)_3$, used in the fertilizer industry as a source of potassium sulfate present in economic quantities in the McNutt Potash Zone.

**Latin hypercube sampling.** A Monte Carlo sampling technique that divides the range of each variable into intervals of equal probability and samples from each interval.

**leachate.** Any liquid, including any suspended components in the liquid, that has percolated through or drained from waste.

**leaching.** The process of extracting a soluble component from a solid by the percolation of a solvent (in this report, water) through the solid.

**Leonardian.** The geologic formation from 8,000 feet to 11,400 feet below the surface at the WIPP. Middle of the Permian Period.

**level-line survey.** A cross-country survey in which changes in elevation with respect to sea level are very carefully measured.

***LHS. The LHS program samples distributions of input parameters using normal Monte Carlo sampling or efficient Latin Hypercube sampling.***

**ligands.** A molecule, ion, or atom that is attached to the central atom of a coordination compound. Ligands are also called complexing agents.

**lithofacies.** A lateral, mappable subdivision of a designated stratigraphic unit, distinguished from adjacent subdivisions on the basis of lithology, including all mineralogic and petrographic characters and those paleontologic characters that influence the appearance, composition, or texture of the rock.

**lithology.** The study and examination of the physical characteristics (color, mineralogic composition, grain size, etc.) of rocks, generally determined from a hand specimen with the aid of a low-powered magnifier.

**lithosphere.** The outer solid shell of the earth considered to be about 50 miles (80 kilometers) in thickness. Composed of the rocks that include both the earth's crust and upper mantle.

**lithostatic pressure.** The vertical pressure at a point in the Earth's crust, equal to the pressure caused by the weight of the overlying rocks.

**Livingston Ridge.** Topographic feature marking the eastern boundary of Nash Draw.

**long term.** Refers to the first 10,000 years after shaft sealing for which performance assessment calculations and models assess the behavior of the repository with respect to compliance with 40 CFR Part 191 and 40 CFR § 268.6.

**Los Medaños.** In this report, the area in southeastern New Mexico surrounding the site proposed for the WIPP repository. In Spanish it means "dune country."

***Los Medaños Member. The lower most member of the Rustler formation, formerly known as the unnamed lower member.***

**lower explosive limit.** The minimum concentration of gas or vapor in air below which a substance does not burn when exposed to an ignition source.

**macromolecule.** A very large molecule (such as proteins, cellulosics, and rubbers) that contains hundreds or thousands of atoms.

**Magenta Dolomite Member.** The upper of two layers of dolomite within the Rustler Formation that are locally water-bearing. Also called the Magenta Member.

**magma.** Naturally occurring molten rock material which is generated within the earth. This material is capable of intrusion and extrusion, from which igneous rocks are derived through solidification and related processes.

**magnitude, earthquake.** A measure of the total energy released by an earthquake. Not to be confused with intensity.

**Malaga Bend.** A sharp bend in the Pecos River 20 miles southeast of Carlsbad, New Mexico, and directly east of the town of Malaga.

**man-rem.** A unit of population dose (see population dose).

**marker beds.** Marker beds are well-defined layers of rock that mark distinct divisions in major geological strata or geological time frames.

**mathematical model.** In the context of the WIPP, mathematical formulations developed to represent the processes at the WIPP site. The conceptual models provide the context within which these mathematical models must operate and define the processes they must characterize. The mathematical models are predictive in the sense that, once provided with the known or assumed properties of the system and possible perturbations to the system, they predict the response of the system. The processes represented by these mathematical models include fluid flow, mechanical deformation, radionuclide transport in groundwater, and removal of waste through intruding boreholes.

**matrix porosity.** The porosity of the matrix or finer parts of a rock, as opposed to the porosity imparted to a rock through fractures, vugs, and voids.

**maximally exposed person.** A hypothetical person who is exposed to a release of radioactivity in such a way that the person receives the maximum possible individual dose or dose commitment. For instance, if the release is a puff of contaminated air, the maximally exposed person is the individual at the point of largest ground-level concentration who stays there during the whole time of the cloud passage. The use of this term is not meant to imply that there is such a person, but only that thought is being given to the maximum exposure a person could receive.

**maximum individual dose.** The highest dose delivered to the whole body or to an individual organ that a person can receive from a release of radioactivity. The hypothetical person who receives this dose, the maximally exposed person, is one whose location and activities maximize the dose. For instance, the person may be at the point of maximum concentration of a radioactive cloud for the whole time it takes to pass.

**MB139.** A marker bed located one m below the WIPP site and is on average one m thick. It consists mostly of anhydrite and clay.

**mCi.** Abbreviation for millicurie. One one-thousandth (0.001) of a curie.

**McNutt Potash Zone or Member.** The middle member of the Salado Formation measuring 348 to 413 ft (106 to 126 m) thick in the vicinity of the WIPP site. This member contains reddish-orange and brown halite with deposits of sylvite and langbeinite from which potassium salts are mined. The McNutt Potash Member was deposited in the Late Permian Period between approximately 258 and 250 million years ago.

**mean.** The average value. For a given set of *n* values, the mean is the sum of their values divided by *n*.

**median.** The median of a set of data is the value such that half of the observations are less than that value and half are greater than that value.

**megapascal.** $10^6$ pascals.

**Mercalli intensity.** A scale of measurement of earthquake intensity.

**Mescalero Caliche.** An informal name for a layer of caliche of varying thickness found in the WIPP area.

**Mescalero Plain.** The Plain is composed of the ground surface east of the Pecos River valley and is one of the principal geomorphic features associated with the WIPP site. It consists of a poorly drained surface covered by gravels, eolian sand, and caliche. The plain has developed since the Early to Middle Pleistocene time (approximately 1.6 million year ago).

**Mesozoic.** An era of geologic time from the end of the Paleozonic Era, 245 million years ago, to the beginning of the Cenozoic era, 66 million years ago. It comprises the Triassic, Jurassic, and Cretaceous period.

**metabolized.** Refers to a material which has been consumed or transformed by the life processes of an organism.

**metamorphic.** Metamorphism is changes in rocks brought on by the effects of temperature, pressure and/or the introduction of new chemical substances. It requires deep burial below the zones of weathering and cementation.

**methanogenesis.** The generation of methane through the decomposition of organic matter in wastes.

**microbial.** The action of microbes or microorganisms. In the context of the WIPP, the term is mainly applied to the waste degradation and gas generation activity of microorganisms.

**mineralization.** The process whereby minerals are precipitated out of a solution into a porous or fracture zone. For example, if the Salado Formation brine is transported to the Culebra Dolomite, cooling may cause the precipitation of salt minerals.

**Miocene.** The fourth of five epochs into which the Tertiary Period is divided; also, the corresponding system of rocks. It is subsequent to the Oligocene Epoch and precedes the Pliocene Epoch (approximately 23.7 to 5.3 million years ago).

**miscellaneous hazardous waste management unit.** A waste management unit where hazardous waste is treated, stored, or disposed of, and that is not a container, tank,

surface impoundment, pile, land treatment unit, landfill, incinerator, boiler, industrial furnace, underground injection well, or unit eligible for a research, development, and demonstration permit (40 CFR § 260.10).

**Mississippian.** Third youngest period of the Paleozonic Era and the corresponding system of rocks. Prior to the Pennsylvanian and representing approximately the interval from 360 to 320 million years ago. Mississippian rocks are present from 15,000 to 15,600 feet below the surface at the WIPP.

**Mississippian Limestone.** The limestone is light gray to brown, finely crystalline and commonly cherty, with a basal dark gray organic-rich shale unit. The limestone partially grades to shale southeastward from the northern margin of the Delaware Basin.

**mixed waste.** Mixed waste contains both radioactive and hazardous components, as defined by the Atomic Energy Act and the Resource Conservation and Recovery Act, respectively.

**model.** An investigative technique using a mathematical or physical representation of a system that accounts for all or some of its known parameters. Models are often used to test the effect of changes of system components on the overall performance of the system.

**model validation.** The process of ensuring (through sufficient testing of a model using actual site data), that a conceptual model, and corresponding mathematical and computer models, correctly simulate a physical process with sufficient accuracy.

**model verification.** The process of ensuring (for example, through tests on ideal problems) that a computer code (computational model) correctly performs the necessary functional operations (such as solving the mathematical model). Given that a computer code correctly solves the mathematical model, the physical assumptions of the mathematical model must then be checked through validation.

***MODFLOW. A computer program that numerically solves the three-dimensional groundwater flow equation for a porous medium by using a finite-difference method.***

**molality.** The molality of a solution is the number of moles of solute in 1,000 g of solvent. A solution which contains one mole of solute in 1,000 g of solvent is called a one-molal solution.

**molarity.** The molarity of a solvent is the number of moles of solute per liter of solution. A solution containing one gram formula weight, or mole, of the solute in one liter of solution is a one-molar solution.

**Monte Carlo Analysis/Technique.** A technique that obtains distribution of approximate solutions to a problem by using statistical sampling techniques and computer simulations. For the WIPP PA, the method is used to evaluate the distribution of the consequence results and thereby approximate the uncertainty in the results.

**Morrow Formation.** This formation was formed in the Early Pennsylvanian Period approximately 320 million years ago. It consists of fine to coarse grain sandstones with dark gray shales and some thin limestones layers present in the upper section. It is approximately 14,000 ft (4,200 m) below the surface at the WIPP and 1,200 ft (366 m) in thickness. The Morrowan sandstones are a source of natural gas production north of the WIPP site.

**MTHM.** Metric tons of heavy metal; used in the release limit described in Appendix A of 40 CFR Part 191.

**mudstone.** An indurated mud having the texture and composition of shale, but lacking its fine lamination or fissility; a blocky or massive, fine-grained sedimentary rock in which the proportions of clay and silt are approximately equal; a nonfissile mud shale.

**multi-mechanism deformation model.** A simulation model developed to help predict the behavior, particularly the rate of room closure, of WIPP underground openings.

**Nash Draw.** A shallow valley, approximately five miles wide, open to the southwest , and located to the west of the WIPP site.

**natural background radiation.** Radiation in the human environment from naturally occurring elements and from cosmic radiation. See background (radiation).

**natural barriers.** The repository host rock and surrounding geologic structures and formations. The natural barriers extend from the engineered barrier to the compliance boundary.

**near future.** Defined for any activity that is initiated prior to shaft sealing (preclosure), even if the completion will occur after shaft sealing (postclosure). The demarcation between near future and future is the date of shaft sealing. All activities initiated after shaft sealing are "future" activities. Any activity initiated prior to shaft sealing is a "near future" activity and is part of the undisturbed performance.

**neutron.** An elementary particle that has approximately the same mass as the proton but lacks electric charge, and is a constituent of all nuclei having mass number greater than one.

**New Mexico Bureau of Mines and Mineral Resources.** The New Mexico Bureau of Mines and Mineral Resources is a division of the New Mexico Institute of Mine Technology.

**nitrates.** The salts from nitric acid generating sodium nitrate and potassium nitrate. These salts are used in the agricultural industry as fertilizers. When used as a fertilizer, nitrates can be a cause for groundwater chemistry changes.

**nondestructive assay.** The remote determination of the radionuclide content inside a waste package.

**non-Salado.** In this report, non-Salado refers to the hydrological aspects of all geologic formations above and below the Salado Formation. It pertains to the conceptual models used for flow and transport of radionuclides within these formations.

**nuclear criticality.** A self-sustaining nuclear chain reaction from sufficient mass of a fissionable material.

**Nuclear Energy Agency.** The Nuclear Energy Agency was established on February 1, 1958 under the name of OEEC European Nuclear Energy Agency. Nuclear Energy Agency membership today consists of all the European member countries of Organisation for Economic Cooperation and Development as well as Australia, Canada, Japan, the Republic of Korea, Mexico and the United States. The primary objective of Nuclear Energy Agency is to promote cooperation among the governments of its participating countries in furthering the development of nuclear power as a safe, environmentally acceptable, and economic energy source.

**nucleation.** The process by which the formation of a crystal or some other particulate from the liquid state, vapor, or solution is begun. Often a minute particle of a foreign substance provides the initial nucleus for crystal growth.

**nuclide.** A species of atom characterized by the number of protons and neutrons in its nucleus.

**nuclide inventory (radionuclide inventory).** A list of the kinds and amounts of radionuclides in a container or a source. Amounts are usually expressed in activity units: curies or curies per unit volume.

**nutrient.** Applies to any substance assimilated by living things that promotes growth. The term generally applies to nitrogen and phosphorus in waste water, but is also applied to other essential and trace elements.

***NUTS. NUTS is a multidimensional, multicomponent radioactive material contaminant transport, single-porosity (SP), dual porosity (DP), and dual permeability (DPM) finite-difference simulator.***

**Ochoan.** The Late Permian Ochoan series consists primarily of evaporites that were deposited during recurrent retreats of a shallow sea restricted by the Guadalupian reefs. The lower three formations in the series, the Castile, Salado and Rustler, comprise what is perhaps the thickest and most extensive evaporite rock sequence in North America.

**Ogallala Formation.** Deposition of the Ogallala began about 12 million years ago, in Miocene time. The Ogallala represents the first preserved sedimentary record in the vicinity of the Delaware Basin since Cretaceous deposition. The Ogallala formed a thick mantle throughout the Permian Basin, producing the even surface of the High Plains, called the Llano Estacado in western Texas and eastern New Mexico. Locally, eolian activity played a part in deposition, and periodically, widespread soils formed.

**one hundred-year storm.** A storm that, on a statistical basis, is expected to recur only once every hundred years.

**oolite.** A sedimentary rock, usually a limestone, made up chiefly of ooliths cemented together. Synonym for roestone and eggstone. An oolith is a spherical or subspherical rock particle that has grown by accretion around a nucleus. The most common type of oolith is calcareous, although primary ooliths of iron minerals are also found.

**order of magnitude.** A factor of ten. When a measurement is made with a result such as $3 \times 10^7$, the exponent of 10 (here 7) is the order of magnitude of that measurement. To say that this result is known to "within an order of magnitude" is to say that the true value lies between (in this example) $3 \times 10^6$ and $3 \times 10^8$.

**Ordovician.** The second oldest period of the Paelozoic Era and also the corresponding system of rocks. It is represented by the rock units between 16,900 ft and 18,200 ft below the surface in the vicinity of the WIPP. The Ordovician Period is subsequent to the Cambrian Period and followed by the Silurian Period, between approximately 505 and 438 million years ago.

**orthogonal reactions.** Chemical reactions that do not affect or interfere with each other.

**osmotic.** The passage of pure liquid from a region of higher solute concentration to a region of lower solute concentration, usually through some intervening solid or liquid barrier such as a membrane, which restricts mixing. Thus, if a volume of dilute salt water is separated from a volume of concentrated brine by a semi-permeable membrane, water is passed by osmosis through the membrane from the dilute solution to the high-salinity brine.

**overpack.** A container put around another container. In the WIPP, overpacks would be used on damaged or otherwise contaminated drums, boxes, and canisters that it would not be practical to decontaminate.

**oxic.** Describes a process that occurs in the presence of oxygen ($O_2$), such as the corrosion of steels, iron-base alloys, and other metal wastes, using $O_2$ and water ($H_2O$) to produce iron oxide and hydrogen gas ($H_2$).

**oxidation.** The chemical process whereby electrons are removed from an atom or ion. Originally referring to chemical reactions involving oxygen, the term is also used to designate any chemical reaction in which the reactant gives up one or more electrons. Thus, when hydrogen ($H_2$) and chlorine ($Cl_2$) react to form 2H+Cl, the hydrogen is "oxidized" by the chlorine. The oxidation state of an ion is expressed as a positive or negative number representing the ionic or effective charge.

**oxides.** Minerals in which cationic atoms are bonded to oxygen atoms.

**packaging.** The assembly of components necessary to ensure compliance with packaging requirements. It may consist of one or more receptacles, absorbent materials, spacing

structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The vehicle, tie-down system, and auxiliary equipment may be designated as part of the packaging.

**Paleozoic.** Major geological era from 245 million years to 570 million years. Denotes a wide range of geological strata from different geological periods (that is, Permian, Pennsylvanian, Mississippian, etc).

**panel.** A group of several underground rooms connected by drifts. Within the WIPP, a panel consists of seven rooms connected by drifts at each end.

**PANEL.** Sandia National Laboratory computer program which simulates the process of waste mobilization.

**parameter.** The underlying elements ($x = x_1, ..., x_n, ..., x_{nV}$) of a computational model. As x changes so does the model result. The individual parameters, $x_n$, may be vectors, tensors, higher order quantities, or even functions, but are usually scalar quantities. Furthermore, the individual parameters are usually coefficients of the mathematical model, but they may also relate to scenario uncertainty or model form uncertainty.

**Pascal.** A unit of pressure obtained by dividing force (in Newtons) by area (in meters squared).

**passive/active neutron analysis.** An assaying technique used to determine the amount of fissionable material in a container of waste. Background neutrons are counted as well as neutrons from artificially-induced fissioning in the waste. The analysis assumes that the isotopic composition is already known.

**passive institutional controls.** "(1) [P]ermanent markers placed at a disposal site, (2) public records and archives, (3) government ownership and regulations regarding land or resource use, and (4) other methods of preserving knowledge about the location, design, and contents of a disposal system." (40 CFR § 191.12)

**Pennsylvanian.** Second-youngest period of the Paleozonic Era and also the corresponding system of rocks. Pennsylvanian rocks are found about 12,800 to 15,000 ft below the Los Medaños surface in the vicinity of the WIPP site and may contain oil and natural gas. Subsequent to the Mississipian Period and followed by the Permian Period, between approximately 320 and 286 million years ago.

**percolate.** The movement of liquid (usually water) through unsaturated or saturated solid and rock.

**performance assessment (PA).** An analysis that (1) identifies the processes and events that might affect the disposal system; (2) examines the effects of these processes and events on the performance of the disposal system; and (3) estimates the cumulative releases of radionuclides, considering the associated uncertainties, caused by all significant processes and events.

**performance modeling.** A process of building models of the factors affecting the containment of nuclear waste to project into the future how the WIPP facility will respond to probabilistic events and processes.

**permafrost.** Permanently frozen ground which occurs at different depths below the ground surface in frigid climates.

**permeability.** In hydrology, the capacity of a rock, sediment, or soil to transmit fluids under specified conditions. It is given by the hydraulic conductivity (K) times the fluid dynamic viscosity ($\mu$) divided by the fluid density ($\rho$) times acceleration due to gravity (g); $k = \mu K/\rho g$.

**Permian Basin.** A region in the Central U.S. where, during Permian times 286 and 245 million years ago, there were many shallow seas that laid down vast beds of evaporites. The Delaware basin is a part of the Permian basin.

**Permian Period.** This period is the last of seven periods of the Paleozonic Era, subsequent to the Pennsylvanian Period; also, the corresponding system of rocks (between approximately 286 and 245 million years ago).

***PEST. The parameter estimation program that can be used with other models to calibrate parameters quickly using a set of known observations.***

**petrological.** Relating to the general study of rocks in all their aspects, including their mineralogies, textures, structures, origins, field occurrences, alterations, and their relationships to other rocks.

**pH.** The symbol used to designate a standard measure of the acidity of a solution. pH is defined as the negative logarithm (base 10) of the activity of hydrogen ion in the solution. Pure water, which is regarded as neutral, has a pH of 7. A lower value of pH would indicate acidity, and a higher value would indicate that a solution is basic (alkaline).

**phenols.** Organic compounds that are by-products of petroleum refining, tanning, and textile, dye, and resin manufacturing. Low concentrations cause taste and odor problems in water; higher concentrations can kill aquatic life and humans.

**physicochemical.** Describes chemically related processes studied for performance assessment purposes that have potential to influence the transport of contaminants throughout the disposal system. These physicochemical processes include alpha recoil, chemical gradients and osmotic activity.

**physiography.** A description of the natural features of the surface of the earth.

***Pipe Overpack. The standard pipe overpack consists of a pipe component surrounded by cane fiberboard and plywood dunnage within a standard 55-gallon drum with a rigid***

***polyethylene liner and lid. It is designed to be used for the shipment of specific contact-handled transuranic waste forms in the TRUPACT-II.***

**pisolitic.** Pertaining to pisolite [sed], or to the texture of a rock made up of pisoliths or pealike grains; for example, pisolitic bauxite or pisolitic limestone.

**Pitzer Formalisms.** A semi-empirical formalism for calculating activity coefficients, particularly in saline aqueous systems.

**plasticity.** The property of a material that enables it to undergo permanent deformation without appreciable volume change or elastic rebound, and without rupture.

**Pleistocene.** This is the first epoch of the Quaternary Period of the Upper-Cenozoic Era; also, the corresponding system of rocks. It is subsequent to the Pliocene Epoch of the Tertiary Period and precedes the Holocene Epoch of the Quaternary Period (between approximately 1.6 million to 10,000 years ago). Climatic changes during this period are used as an analog in estimating future climatic extremes for the WIPP.

**Pliocene.** The last epoch of the Tertiary Period of the Middle-Cenozoic Era; also, the corresponding system of rocks. It is subsequent to the Miocene Epoch of the Tertiary Period and preceded by the Pleistocene Epoch of the Quaternary Period (between approximately 5.3 and 1.6 million years ago).

**plug.** A watertight or gastight seal installed in a borehole or well to prevent movement of fluids or gas. Also used to fill in or seal off fractures, cavities, or other porosity in the walls of a borehole. Commonly a cement plug is used in the sealing of boreholes or wells associated with oil, gas, or water exploration.

**plutonium.** A metallic, radioactive actinide, symbol Pu, atomic number 94, in the transuranium series of elements; used as a nuclear fuel and as the fissile agent in nuclear weapons.

**plutonium equivalent curie.** A term developed to provide a uniform basis among various radioactive wastes to perform comparative human health consequence analyses resulting from inhalation. The plutonium equivalent curie concept has strict limits of applicability. It is utilized herein as a means of expressing the transuranic activity content of transuranic waste packages.

**pmH.** The symbol used to designate a standard measure of the acidity of a solution. pmH is defined as the negative logarithm of the molal concentration of hydrogen ion in solution.

**Poços de Caldas.** A location in Brazil where two uranium deposits were investigated for the possibility that the flow of fluids might lead to the development and migration of a large-scale redox front.

**point data.** Discrete actual data collected by directly observing and recording a measurable event or attribute.

**point source.** A source of effluents that is small enough in dimensions that it can be treated as if it were a point. The converse (not used in this document) is a diffuse source. A point source can be either a continuous source or a source that emits effluents only in pulses or for a short time.

**polyelectrolyte.** A substance of high molecular weight (as a protein or a nuclide).

**polyhalite.** An evaporite mineral: $K_2MgCa_2(SO_4)_4 \cdot 2H_2O$. It is a hard, nearly insoluble mineral with no economic value.

***Polypropylene "supersacks". Sacks containing 4000 pounds of magnesium oxide which are placed on top of the three high seven-packs of waste that has been placed underground.***

**population dose.** The sum of the radiation doses received by the individual members of a population.

**porosity.** The ratio of the void volume in a rock or soil to its total volume. It may be stated as a percentage or as a decimal.

**process.** A physical, natural, or anthropogenic phenomenon that occurs continuously or over a significant portion of the time frame of interest. In other words, a "long-term" phenomenon.

**portlandite.** An ingredient of Portland cement [$Ca(OH)_2$].

**possible futures.** The set of all possible occurrences within the 10,000-year regulatory time frame.

**postclosure phase.** A designated period of time beginning with the end of the decommissioning phase and extending through the end of the regulatory time frame of 10,000 years. PA modeling of repository behavior addresses this time frame.

**potash.** A potassium compound used in agriculture and industry.

**potassium.** A silver-white metallic element of the alkali metal group. It occurs abundantly in the McNutt Potash Zone in the vicinity of the WIPP site.

**potentiometric surface.** A subsurface map of the hydraulic potentials of an aquifer. It is usually represented in figures as a contour map, each point estimating how high the water would rise in a well tapping that aquifer at that point.

**Precambrian.** Applies to all geologic time, and its corresponding rocks, before the beginning of the Paleozonic Era, 570 million years ago. The Precambrian basement is approximately 18,000 feet (5,486 meters) below the surface in the vicinity of the WIPP site.

**probabilistic analysis.** Analysis that arose from statistical investigations is referred to as probabilistic analysis. This analysis is characterized by the fact that, although specific outcomes of an experiment cannot be predicted with certainty, relative frequencies for various possible outcomes are predictable. Monte Carlo analysis is used for probabilistic analysis of the WIPP.

**Project Gnome.** The Plowshare Project Gnome Test, an underground nuclear test, took place on December 10, 1961, at a location approximately 8 mi (13 km) southwest of the WIPP site. Its primary purpose was to study the effects of a nuclear explosion in salt. The site was decommissioned in 1979, but continues to be monitored by the EPA for radioactive contamination.

***Projected Inventory. The part of the TRU inventory that has not been generated, but is estimated to be generated at some time in the future, by the TRU waste sites. The projected inventory is the same as the to-be-generated waste referred to in 40 CFR 194.24(a).***

**promulgation.** Referring to the process of putting regulations into law.

**Public Law 96-164.** The U.S. Department of Energy National Security and Military Applications of Nuclear Energy Act of 1980. Public Law 96-164 directed the DOE to proceed with the design and development of the WIPP.

**Public Law 102-579.** See Land Withdrawal Act.

**quality assurance.** The planned and systematic actions necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service.

**Quality Assurance Project Plans.** This document identifies the quality of data necessary, and the techniques designed to attain and ensure the required data quality objectives associated with the WIPP waste characterization program.

**quality control.** Those quality assurance activities that provide a means to control and measure the characteristics of a structure, system, or component to established requirements.

**Quaternary.** The last period of the Cenozoic Era; also, the corresponding system of rocks. It is subsequent to the Tertiary Period, beginning approximately 1.6 million years ago and extends to the present.

**rad.** See radiation absorbed dose.

**radially.** The term "radial" is the adjective of "radius" and is used to describe forces that act in directions parallel to some radius or to designate lines, fractures, flow paths, etc., that are oriented parallel to radii. "Radially" is the corresponding adverb. Effects that act

outward from a single point or inward toward a point (for example, flow of groundwater toward a borehole) may be radial in form.

**radiation absorbed dose (rad).** The special unit of absorbed dose of ionizing radiation. One rad of absorbed dose is equal to the absorption of 100 ergs of radiation energy per gram of absorbing material. See also rem.

**radioactive decay.** A process whereby the nucleus of an atom spontaneously emits excess energy by emitting particles and/or rays (alpha, beta, gamma, or neutrons).

**radioactive material.** Matter composed of or containing radionuclides, with radiological half-lives greater than 20 years, subject to the Atomic Energy Act of 1954, as amended. (40 CFR § 191.12)

**radiographic examination.** The nondestructive technique that enables a qualitative evaluation of the contents of a waste container.

**radiolysis.** Chemical decomposition by the action of radiation.

**radiometric.** Pertaining to the measurement of geologic time by the study of parent and/or daughter isotopic abundances and known disintegration rates of the radioactive parent isotopes, for example, radiometric dating.

**radionuclide.** An isotope having an unstable nucleus, that is subject to spontaneous decay.

**reactant.** A substance that enters into a chemical reaction and is altered. For example, metal waste reacts with oxygen and water to produce hydrogen and metal oxides.

**real-time radiography.** A type of remote Non-Destructive Test that uses a luminescent screen to form a moving image from x-rays that have passed through a rotating test object. Real-time radiography is relied on for detection of waste form shapes and the presence of liquids inside the waste package.

**reasonable.** (1) Not conflicting with reason; (2) not extreme or excessive; (3) having the faculty of reason; or (4) possessing sound judgment.

**recharge.** The amount of water and the processes involved in the addition of water to an aquifer.

**recharge point (or area).** In groundwater hydraulics, the point (or area) where surface water enters an aquifer.

**recovery.** The process of getting something back. The term “resource recovery” is often used to indicate the mining of minerals or the withdrawal of oil or natural gas from beneath the surface of the Earth through wells.

**recrystallization.** The formation, initially in the solid state, of new crystalline mineral grains in a rock. The new grains are generally larger than the original grains and may have a different mineralogical composition. It is usually caused by increased temperatures and pressures exerted on a rock formation.

**regulatory time frame.** As defined in 40 CFR Part 194, the regulatory time frame means the time period beginning with disposal and ending 10,000 years after disposal.

**release.** Movement of regulated substances into the accessible environment as defined in 40 CFR Part 191 or beyond the unit boundary as defined for 40 CFR § 268.6.

**rem.** Roentgen equivalent in manCa special unit of dose equivalent which is the product of absorbed dose, a quality factor which rates the biological effectiveness of the radiation types producing the dose, and other modifying factors (usually equal to one). If the quality and modifying factors are unity, 1 rem is equal to 1 rad: 100 rem = 1 Sievert (SI units). Also expressed in terms of millirem (mrem): 1 rem = 1,000 mrem.

**remote-handled transuranic waste.** Packaged transuranic waste that has a measured external surface dose rate at or greater than 200 millirems per hour at the surface of the container.

**repository.** The portion of the WIPP underground system within the Salado Formation, including the access drifts, waste panels, and experimental areas, but excluding the shafts.

**repository/shaft system.** The WIPP repository underground workings, including the shafts, all engineered and natural barriers, and the altered zones within the Salado Formation and overlying units resulting from construction of the underground workings.

**repressurization.** The increase in pressure in a previously depleted volume that might be associated with a fluid injection.

**reserves.** Mineral resources that can be extracted profitably by existing techniques and under present economic conditions.

**reservoir.** A subsurface volume of rock that has sufficient porosity and permeability to permit the accumulation of oil, gas, or water under adequate trap conditions. Also applies to any natural or artificial surface holding area used to store, regulate, or control water.

**residuum.** An accumulation of rock debris formed by weathering and remaining essentially in place after all but the least soluble constituents have been removed, usually forming a comparatively thin surface layer concealing the unweathered or partly altered rock below.

**resistivity.** Measure of electrical resistance in a fluid such as brine.

**resources.** Mineralization that is concentrated enough, in large enough quantity, and in a physical and chemical form such that its extraction is currently or potentially feasible and profitable.

**retardation.** Attenuation of contaminant concentration with migration distance. There are a variety of physical and chemical processes that can contribute to retardation.

**retrievable.** Describes storage of radioactive waste in a manner designed for potential recovery without loss of control or release of radioactivity.

**Richter scale.** A logarithmic scale expressing the magnitude of a seismic disturbance (as an earthquake) in terms of the energy dissipated in it with 2 being the lowest and 8.5 being the largest earthquakes yet recorded.

**Rio Grande Rift.** The rift system of the Rio Grande valley in which the crustal plate has split and a series of grabens have formed in New Mexico and Southern Colorado. It is a product of extensional tectonics.

**room.** An excavated cavity within a panel in the underground portion of the WIPP, a room is about 10 meters wide, 4 meters high, and 91 meters long.

**rubidium-strontium age.** Determination of an age for a mineral or rock in years based on the ratio of radiogenic strontium-87 to rubidium-87 and the known radioactive decay rate of rubidium-87. If ratios are measured for more than one phase of a single rock, or for a number of related rocks that differ in rubidium content, an isochron may be drawn.

**Rustler Formation.** The evaporite beds, including mudstones, of probable Permian age that immediately overlie the Salado Formation.

**Salado Formation.** A geologic formation of Late Permian age in southeastern New Mexico. At the WIPP site, it is composed of salt beds with minor amounts of anhydrite (45 numbered anhydrite marker beds: Marker Bed 101 through Marker Bed 145) and clay. It is the host unit for the WIPP repository.

**saline.** Waters are considered saline when they contain between 10 and 100 parts per thousand salinity. See brackish and brine.

**saline intrusion.** A human-induced coastal process whereby subsurface seawater progressively replaces freshwater withdrawn from an aquifer being pumped close to the shoreline.

**Sandia National Laboratories.** A multiprogram laboratory located in Albuquerque, NM, and Livermore, CA. SNL is operated and managed for the DOE by the Sandia Corporation. From 1949 until October 1993, Sandia Corporation was a wholly owned subsidiary of AT&T. Sandia Corporation is currently a wholly owned subsidiary of Lockheed-Martin Corp.

**San Simon Sink.** The central, most depressed area of San Simon Swale.

**San Simon Swale.** A broad depression about 15 miles east of the Los Medaños site, open to the southeast.

**Santa Rosa Formation.** The Santa Rosa Sandstone is a principal aquifer in several areas, particularly in Winkler and Ward Counties, Texas. It produces both fresh and saline water, depending on location. The westernmost extent of the Santa Rosa Sandstone is just into Eddy County. Wells completed in the Santa Rosa Sandstone have low yields with specific capacities of 0.14-0.2 gpm per foot of drawdown; the formation porosity is about 13 percent.

***SANTOS. A finite element program designed to compute the quasistactic, large deformation, inelastic response of two-dimensional planar or axisymmetric solids or engineering structures.***

**saturated.** A condition in which all connected pores in a given volume of material contain fluid.

**scarp.** A line of cliffs produced by faulting or by erosion. The term is an abbreviated form of escarpment, and the two terms commonly have the same meaning, although "scarp" is more often applied to cliffs formed by faulting.

***Scaled Inventory. Synonymous with Disposal Inventory. The scaled inventory is the inventory volume that fills WIPP capacity and is used for PA calculations. This volume is calculated as the sum of the disposal volumes for all WIPP-eligible waste streams after application of RH-TRU and CH-TRU scaling computations to each WIPP-eligible projected TRU waste stream.***

**scenario.** A combination of naturally occurring or human-induced events and processes that represent realistic future changes to the WIPP repository, geologic, and geohydrologic systems that could cause or promote the escape of radionuclides and/or hazardous constituents from the WIPP repository.

**screening argument.** Regulatory Guidance, Probability of Occurrence, and Consequence are three criteria used to eliminate from scenario development those events and processes that are not applicable to a specific disposal system or that do not have the potential of contributing significantly to the performance measure (for example, integrated radionuclide releases).

**seal.** An engineered barrier designed to isolate the waste and to impede groundwater flow in the shafts.

**sealing system.** Includes all components of the WIPP seal design program.

***SECOTP2D. A computer program that simulates single or multiple component radionuclide transport in fractures or granular aquifers.***

**sedimentary.** A descriptive term for rocks formed of sediment, such as clastic rocks (sandstones and shales), secretions of organisms, limestones, and precipitation from solution, rock salts and gypsums.

**sedimentation.** The process of accumulating sediment into layers of solid rock which includes the generaiton of rock particles, the transportation and the deposition of these particles, and the consolidation of these particles into solid rock.

**seismic.** Applies to the activity of naturally- or artificially-induced earthquakes or earth vibrations, where the seismic waves are the elastic waves produced by these vibrations.

**seismic risk zone.** A designation of a geographic region expressing the maximum intensity of earthquakes that could be expected there.

**sensitivity analysis.** Methods for computing the effect of changes in the input parameters on the model predictions.

**seral.** Relating to a series of ecological communities formed in ecological succession.

**sequestration.** To hold (as a metallic ion) in solution.

**shaft.** A man-made hole, either vertical or steeply inclined, that connects the surface with the underground workings of a mine.

**shaft pillar.** The cylindrical volume of rock around a shaft from which major underground openings are excluded in order that they do not weaken the shaft.

**shallow-dissolution zone.** A zone of residual material at the interface of the Rustler and Salado formations left after dissolution of salt. It is highly permeable and often contains brine.

**SI unit.** See System of International Units.

**Sievert.** The SI unit of effective dose. It is equal to 100 rem or one joule per kilogram. (40 CFR § 191.12)

**siliciclastic.** Pertaining to clastic noncarbonate rocks which are almost exclusively silicon-bearing, either as forms of quartz or as silicates.

**siltstone.** An indurated silt having the texture and composition of shale but lacking its fine lamination or fissility; a massive mudstone in which the silt predominates over clay; a nonfissile silt shale.

**Silurian.** Third-oldest period of the Paleozonic Era, and also the corresponding system of rocks. Subsequent to the Ordovician Period and followed by the Devonian Period, between approximately 438 and 400 million years ago. The Silurian of the southeast New Mexico

- west Texas area consists of the Fusselman limestone and the carbonates and shales of an Upper Silurian unit, both of which were deposited in the broad subsiding area named the Tobosa Basin.

**Simpson.** In the Delaware basin, the Simpson consists of three main layers of limestone, alternating with thinner green, brown, and black shale, black shale with rounded quartz grain inclusions, and sandstone.

**site characterization.** The process of making geologic and environmental studies to identify potential sites for mined geologic repositories. Detailed site characterization goes further: additional data are collected that would be necessary if a license application were to be submitted.

**SKI (Statens Kärnkraftinspection).** An abbreviation for the Swedish Nuclear Power Inspectorate, Statens Kärnkraftinspection. A list of potentially relevant features, events, and processes developed by SKI was considered to be the best documented and most comprehensive starting point for the WIPP scenario development process.

**sludge.** Refers to de-watered contact-handled transuranic wastes containing both organic and inorganic constituents that must meet the Waste Acceptance Criteria for shipment and disposal at the WIPP repository. High sludges are contact-handled transuranic waste where the sludge component constitutes 50 percent or more of the waste volume; low sludges are the same type of waste containing less than 50 percent by volume of sludge.

**SO-C.** Screened-out on the basis of consequence. The term applies to the elimination of features, events, and processes from PA and compliance assessment calculations for WIPP compliance efforts on the basis of consequence.

**solifluction.** The slow downslope flow of waterlogged soil that is commonly active in periglacial regions underlain by frozen ground that acts as a downward barrier to water percolation.

**SO-P.** Screened-out on the basis of low probability. The term applies to the elimination of features, events, and processes from PA and compliance assessment calculations for WIPP compliance efforts on the basis of low probability of occurrence.

**SO-R.** Screened-out on the basis of regulations. The term applies to the elimination of features, events, and processes from PA calculations used for WIPP compliance efforts on the basis of regulations provided in 40 CFR Part 191 and criteria provided in 40 CFR Part 194.

**solubility.** The ability or tendency of one substance to blend uniformly with another (for example, solid in liquids, liquid in liquid, gas in liquid, and gas in gas). Solids vary from 0 to 100 percent in their degree of solubility in liquids depending on the chemical nature of the substance(s); to the extent that they are soluble, they lose their crystalline form and

become molecularly or ionically dispersed in the solvent to form a true solution. Liquids and gases are often said to be miscible in other liquids and gases rather than soluble.

**solute.** A substance which is dissolved in another substance called the solvent. The solute is uniformly dispersed in the solvent either molecularly or ionically.

**solution.** A mixture, liquid, solid, or gaseous, in which the components are uniformly distributed throughout the mixture.

**solution subsidence.** Gradual subsidence of nonsoluble strata due to the dissolution of underlying rock.

**solvent.** A substance capable of dissolving another substance (solute) to form a uniform dispersed mixture (solution) at the molecular or ionic level. Solvents are, accordingly, characterized as either polar or non-polar. Water is strongly polar; hydrocarbon solvents are non-polar.

**soret effect.** The principle that asserts when temperature differences are induced in a solution of common salt or other substance in water, the dissolved material will become relatively concentrated in those portions in which the temperature is lowest.

**sorption.** The binding on a microscopic scale of one substance to another, such as by adsorption or ion exchange. In this document, the word is especially used in the sorption of solutes onto aquifer solids.

**source term.** The kinds and amounts of radionuclides that make up the source of a potential release of radioactivity. See nuclide inventory.

**spallings.** During exploratory drilling, waste surrounding the eroded borehole that is transported by waste-generated gas escaping to the lower pressure borehole.

**specific activity.** Radioactivity per unit weight of radioactive material.

**standard waste box.** A waste container measuring approximately 6 by 4.5 by 3 feet high, with rounded ends.

**steady-state.** A state or condition of a system or process that does not change over time; a condition that changes only negligibly over a specified time.

**stochastic uncertainty.** As used in probabilistic risk assessment, stochastic uncertainty characterizes uncertainty involving conceptual models and/or the future.

***Stored Inventory**. Also referred to as "retrievably stored" inventory. The part of the anticipated waste inventory that is stored in such a fashion that it can be readily retrieved. Retrievably stored waste includes waste stored at the TRU waste sites since approximately 1970 in buildings or berms with earthen cover and does not include any*

***waste generated prior to 1970. Retrievably stored waste also includes waste that is stored in underground storage tanks, ponds, and as decontamination and decommissioning material identified for disposal that requires retrieval at the TRU waste sites.***

**strata.** Geologic term for layers of the earth's crust. The crust was generally laid down in layers during geological epochs.

**stratigraphy.** The science and study of the origin, composition, and proper sequence in which various rock strata were layered during various geological ages.

**strike slip fault.** A fault on which the movement is parallel to the fault's strike.

**structure map.** A map that portrays subsurface configuration by means of structure contour lines.

**subduction zone.** A long, narrow belt in which subduction takes place. For example, along the Peru-Chile trench, where the Pacific plate descends the South American plate.

**study area.** The region about the Los Medaños site studied in the evaluation of that site.

**subjective uncertainty.** Subjective uncertainty derives from a lack of knowledge about quantities, attributes, or properties believed to have a single or certain range of values.

**subsidence.** The downward settling of the earth's surface with little or no horizontal motion. Subsidence may be caused by natural geological processes or by man-made activities.

**substrate.** The surface and/or nutrient on which an organism will live and grow.

**subsurface.** The rock and soil below the ground surface whose geological features, principally stratigraphy and structure, are interpreted primarily on the basis of drilling activities and geophysical evidence.

**subvertical.** Used to describe planar features oriented within approximately 15 degrees of vertical.

**sulfates.** Mineral compounds characterized by the sulfate radical $S0_4$. Anhydrous sulfates, such as barite, $BaS0_4$, have divalent cations linked to the sulfate radical; hydrous and basic sulfates, such as gypsum, $CaSO_4$-$2H_20$, contains water molecules.

**supersaturation.** A solution, such as the Salado Formation brine, that contains more of a solute (radioactive isotope) than is normally present when equilibrium is established.

**swipe samples.** The presence of radioactive contaminants may be ascertained by applying a Kim-wipe™ or equivalent to the surface of the potentially contaminated item and measuring the radioactivity of the Kim-wipe™.

**sylvite.** A mineral, KCl, used in the manufacture of fertilizer.

**syndeposition.** Processes occurring during deposition of a sedimentary rock, and contributing to the formation of the sedimentary framework.

**System of International units.** The version of the metric system which has been established by the International Bureau of Weights and Measures and is administered in the United States by the National Institute of Standards and Technology. The abbreviation for this system is "SI." (40 CFR § 191.12)

**Tamarisk Member.** The middle anhydrite layer of the Rustler Formation.

**Tansill Formation.** The Tansill Formation is the uppermost formation of the Artesia Group, developing in the Mid-Permian Period, between approximately 280 and 260 million years ago. The Artesia Group represents the shelf region of the Goat Seep Formation and the Capitan Limestone. To the south of the Delaware Basin the Tansill Formation consists of dolomites and sandstones. Toward the northern part of the basin, gypsum and anhydrite along with siltstones and dolomites increase in the Tansill Formation. The Tansill Formation is time correlative to the Capitan Reef at the basin margin and the Bell Canyon Formation in the Delaware Basin.

**tectonics.** The branch of geology dealing with regional structural or deformational features.

**tensile.** Refers to tension in the mechanical sense. A material is under tension when the stress exerted on it (tensile stress) acts "outward" such that the effect is to increase the length or volume of the body.

**Tertiary Period.** The first of two periods in the Cenozoic Era and the corresponding system of rocks. It is subsequent to the Cretaceous Period of the Mesozoic Era and is followed by the Quaternary Period of the Cenozoic Era. The Tertiary Period dates between approximately 66.4 and 1.6 million years ago.

**thermal effect.** The effects of naturally occurring heat on groundwater flow.

**thermal field.** The field or set of temperatures throughout a volume. Use of the term usually connotes temperatures that differ from point to point.

**thermal gradient.** The rate of change of temperature in the direction of increasing temperature.

**thermodynamic.** A term that deals with the relations between heat and other forms of energy. A system is at thermodynamic equilibrium when there is no tendency for change in the free energy of the system,

**thief zone.** A rock unit responsible for excessive fluid loss from boreholes during drilling or production operations.

**topographic/topography.** Relating to or concerning the configuration of a surface that includes relief and the position of its natural and man-made features.

**transient.** This term is used to describe changing state or condition as in ground motion due to seismic activity, or groundwater flow resulting from changing fluid densities.

**transmissivity.** The rate at which water is transmitted through a unit thickness of an aquifer. It is considered a property of the aquifer. The contained liquid is transmissible.

**transport.** For regulatory purposes relating to moving waste to the repository. The movement of radioactive wastes across public routes via the use of packaging as the transportation container and the movement of a hazardous substance by any mode, including pipeline (as defined in the Pipeline Safety Act). In the case of a hazardous substance that has been accepted for transportation by a common or contract carrier, the term "transport" or "transportation" shall include any stoppage in transit that is temporary, incidental to the transportation movement, and at the ordinary operating convenience of a common or contract carrier, and any such stoppage shall be considered as a continuity of movement and not as the storage of a hazardous substance. When addressing the performance of the geologic repository, "transport" refers to the movement of material by mechanisms such as solution, or association with colloids, in groundwater or water from other sources flowing through the repository, seepage of gas through fractured or porous media, or entrainment in drilling fluid, brine, or gas flowing in a borehole.

**transuranic.** See Transuranic Waste.

**transuranic nuclide.** A nuclide with an atomic number greater than that of uranium (92). All transuranic nuclides are produced artificially and are radioactive.

**Transuranic Package Transporter-II.** A package designed to transport contact-handled transuranic mixed waste to the WIPP site. It is a cylinder with a flat bottom and a domed top that is transported in the upright position. Also called TRUPACT-II.

**transuranic waste.** The term "transuranic waste" means waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for: (1) high-level radioactive waste; (2) waste that the Secretary has determined, with the concurrence of the Administrator, does not need the degree of isolation required by the disposal regulations; or (3) waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR 61.

**treatment.** Any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste, or so as to recover energy or material resources from the waste, or so as to render such waste non-hazardous, or less hazardous; safe to transport, store, or dispose of; or amenable for recovery, amenable for storage, or reduced in volume.

**Triassic.** The first period of the Mesozoic era (after the Permian of the Paleozonic Era, and before the Jurassic), thought to have covered the span of time between 225 and 190 million years ago; also, the corresponding system of rocks. The Triassic is so named because of its threefold division in the rocks of Germany.

**true solution.** A uniformly dispersed mixture at the molecular or ionic level, of one or more substances (solute) in one or more substances (solvent). Solutions that exhibit no change of internal energy upon mixing and have complete uniformity of cohesive forces are considered true.

***TRUPACT-II TDOP (10 drum overpack). A container that is designed for use either with the TRUPACT II Shipping Package or as a standalone Department of Transportation (DOT) 7A Type A packaging. The container was designed to hold ten 55-gallon drums, loose homogenous materials, or one Standard Waste Box (SWB).***

***TRU Waste Inventory Update. Los Alamos National Laboratory (LANL), Carlsbad Office performed an inventory update of TRU Waste planned for disposal at WIPP. LANL collected updated inventory data from each of the generator sites which will be shipping TRU Waste to the WIPP. The inventory will not replace the Baseline Inventory Report (BIR), Rev. 3, it will be a standalone document representing the best estimate of TRU Waste remaining to be shipped.***

**Type A Packaging.** A packaging designed to retain the integrity of containment and shielding required by this part under normal conditions of transport as demonstrated by the tests set forth in 49 CFR § 173.465 or 173.466, as appropriate.

**uncertainty analysis.** (1) An evaluation to determine the uncertainty in model predictions that results from imprecisely known input variables; or (2) Determination of the degree of uncertainty in the results of a calculation based on uncertainties in the input parameters and underlying assumptions. Such an analysis requires definition of a system, description of the uncertainties in the factors that are to be investigated, and the characteristics of the system that are to be simulated.

**underpressurized.** A zone or rock formation (Culebra Dolomite or perhaps units underlying the Salado Formation ) that falls below the expected pressure gradient as depth increases.

**undisturbed performance.** "[T]he predicted behavior of a disposal system, including consideration of the uncertainties in predicted behavior, if the disposal system is not disrupted by human intrusion or the occurrence of unlikely natural events." (40 CFR § 191.12)

**uninterruptible power supply.** A power supply that provides automatic, instantaneous power, without delay or transients, on failure of normal power. It can consist of batteries or full-time operating generators. It can be designated as standby or emergency power

depending on the application. Emergency installations must meet the requirements specified for emergency.

**unit boundary.** In the context of 40 CFR § 268.6, the unit boundary is that point at which migration occurs if hazardous constituents pass that point in concentrations exceeding health-based levels.

**uplift.** A structurally high area in the crust, produced by positive movements that raise or upthrust the rocks, as in a dome or arch.

**Upper Devonian Woodford Shale.** The Woodford is a dark brown to black, fissile, bituminous, spore-bearing shale which becomes [arenaceous] northward and contains black [chert] to the south and west.

**U.S. Department of Energy.** The cabinet-level U.S. Government agency responsible for weapons production, energy research, and for the subsequent cleanup of hazardous and radioactive waste sites. It was created from the Energy Research and Development Administration and other federal government functions in 1977. DOE is also responsible for the construction and oversight of WIPP primarily through its Carlsbad Area Office.

**U.S. Environmental Protection Agency.** (1) An independent agency of the Federal government formed in 1970 by Presidential executive order, bringing together parts of various government agencies involved with the control of pollution, and responsible for pollution abatement and control programs, including programs in air and water pollution control, water supply and radiation protection, solid and toxic waste management, pesticides control, and noise abatement; (2) The Agency for those implementation responsibilities for the Waste Isolation Pilot Plant, given to the Agency by the Waste Isolation Pilot Plant Land Withdrawal Act (Pub. L. 102-579, 106, Stat. 4777) which are:

*(i) Determinations by the Agency that the Waste Isolation Pilot Plant is in compliance with Subpart A of this part;*

*(ii) Issuance of criteria for the certifications of compliance with subparts B and C of this part of the Waste Isolation Pilot Plant's compliance with subparts B and C of this part;*

*(iii) Certifications of compliance with subparts B and C of this part of the Waste Isolation Pilot Plant's compliance with subparts B and C of this part;*

*(iv) If the initial certification is made, periodic recertification of the Waste Isolation Pilot Plant's continued compliance with subparts B and C of this part;*

*(v) Review and comment on performance assessment reports of the Waste Isolation Pilot Plant; and,*

*(vi) Concurrence by the Agency with the Department's determination under § 191.02(i) that certain wastes do not need the degree of isolation required by subparts B and C.*

**U.S. Energy Research and Development Agency.** Energy Research and Development Agency, a forerunner of the DOE that was formed in 1974 (Pub. L. 93-438).

**U.S. Geological Survey.** U.S. Geological Survey, Department of Interior.

**valence state.** The degree of oxidation (oxidation state) of an element or atom. It is usually expressed as a positive or negative number representing the ionic charge or effective charge of the element of atom.

**Van Horn Sandstone.** Clastics of the late Precambrian age that crop out near Van Horn, Texas and are overlain by the Bliss Sandstone.

**varve.** In its broadest sense, a varve is a usually thin layer of sedimentary rock that was deposited in a single year. The term is most commonly used to describe sediments deposited in glacial meltwater lakes that exhibit a sequence of alternating coarser and finer layers representing summer and winter deposition, respectively.

**vector.** A quantity or guide that requires a magnitude, direction and sense. It is commonly represented by a line, but also includes the direction of a substance (or activity) such as the flow of water in a general direction. As used in PA, the term is also used to describe model results from one set of parameters selected through statistical techniques.

**viscosity.** A property of fluids which is displayed by definite resistance to change of form. Many solids show a gradual yielding to forces tending to change their form. This property, a sort of internal friction, is also called viscosity.

**volatile organic compounds.** An organic compound that evaporates (volatilizes) readily at room temperature.

**vug.** Small open cavity in a rock.

**Waste Acceptance Criteria.** A set of conditions established for permitting transuranic wastes to be packaged, shipped, managed, and disposed of at the WIPP.

**waste characterization.** Sampling, monitoring, and analysis activities to determine the nature of the waste to be emplaced at the WIPP.

***Waste characteristic. 40 CFR 194.2 includes a regulatory definition of waste characteristic: Waste characteristic means a property of the waste that has an impact on the containment of waste in the disposal system.***

***Waste component. 40 CFR 194.2 includes a regulatory definition of waste component: Waste component means an ingredient of the total inventory of the waste that influences a waste characteristic.***

**waste disposal panels.** A collection of disposal rooms in the WIPP repository. Each panel will be sealed as a unit.

**waste form.** A term used to emphasize the physical and chemical properties of the waste.

**Waste Isolation Pilot Plant.** (1) The project authorized under § 213 of the DOE National Security and Military Application of Nuclear Energy Authorizations Act of 1980 (Public Law 96-164; Stat. 1259, 1265) to demonstrate the safe disposal of radioactive waste materials generated by atomic defense activities; (2) A research and development facility, located near Carlsbad, New Mexico, to be used for demonstrating the safe disposal of transuranic wastes from DOE activities.

**waste matrix.** The material that surrounds and contains the waste and to some extent protects it from being released into the surrounding rock and groundwater. Only material within the canister (or drum or box) that contains the waste is considered part of the waste matrix.

**waste stream.** A grouping of waste materials with specific definable characteristics that remain the same throughout the process generating the waste stream. A waste stream is produced by a single process or subprocess or may be combined to produce a single output waste stream.

**waste unit factor**. The waste unit factor is the normalizing factor used to determine the release limits for 40 CFR § 191.13(a). The term is the same as the "unit of waste" defined in 40 CFR Part 191 Appendix B, Table 1, note e, as "an amount of transuranic wastes containing one million curies of alpha-emitting transuranic radionuclides with half-lives greater than 20 years." For the WIPP, the overall quantity of radionuclides that apply to the waste unit is $4.07 \times 10^6$ curies, and the waste unit factor is therefore 4.07.

**wicking.** The mechanism by which a liquid can migrate through an unsaturated zone against the forces of gravity and surface tension in the soil. Also called capillary rise.

**Wink Sink.** Wink Sink is located 100 mi (160 km) southeast of the WIPP site outside the Delaware Basin. The surface impression is 360 ft (110 m) in width and 110 ft (34 m) deep. It is the result of dissolution of the Salado Formation caused by percolation of shallow groundwater through abandoned boreholes. Subsequent subsidence of the rock units overlying the Salado Formation led to the collapse feature present on the surface.

**WIPP site boundary.** The boundary that defines the outer limits of the 16-section land withdrawal area. For the purposes of this application, this boundary defines the controlled area.

**Wolfcampian.** Lower member of Permian age in Southeastern New Mexico.

**working agreement.** Appendix B of the Agreement of Consultation and Cooperation, which sets forth the working details of that Agreement.

**X-ray.** Any of the electromagnetic radiations of the same nature as visible radiation but of extremely short wavelength (less than 100 angstroms). X-rays are produced by bombarding a metallic target with fast electrons in vacuum or by transition of atoms to lower energy states, and have the properties of ionizing a gas upon passage through it, of

penetration various thicknesses of all solids, of producing secondary radiations by impinging on materials bodies, of acting on photographic films and plates as light does, and of causing fluorescent screens to emit light.

**Yates Formation.** The Yates Formation is one of five formations in the Artesia Group developing in the Mid-Permian Period, between approximately 280 and 260 million years ago. It is subsequent to the Seven Rivers Formation and is preceded by the Tansill Formation. The Tansill Formation, Seven Rivers Formation, and the Yates Formation represent the shelf region of the Capitan Limestone at the margin of the Delaware Basin. To the south it consists of dolomites and sandstones. Siltstones, mudstones, and dolomites increase toward the northern part of the basin. The Yates Formation is time correlative to the Capitan Reef at the basin margin and the Bell Canyon Formation in the Delaware Basin.